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THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

INTRODUCTORY

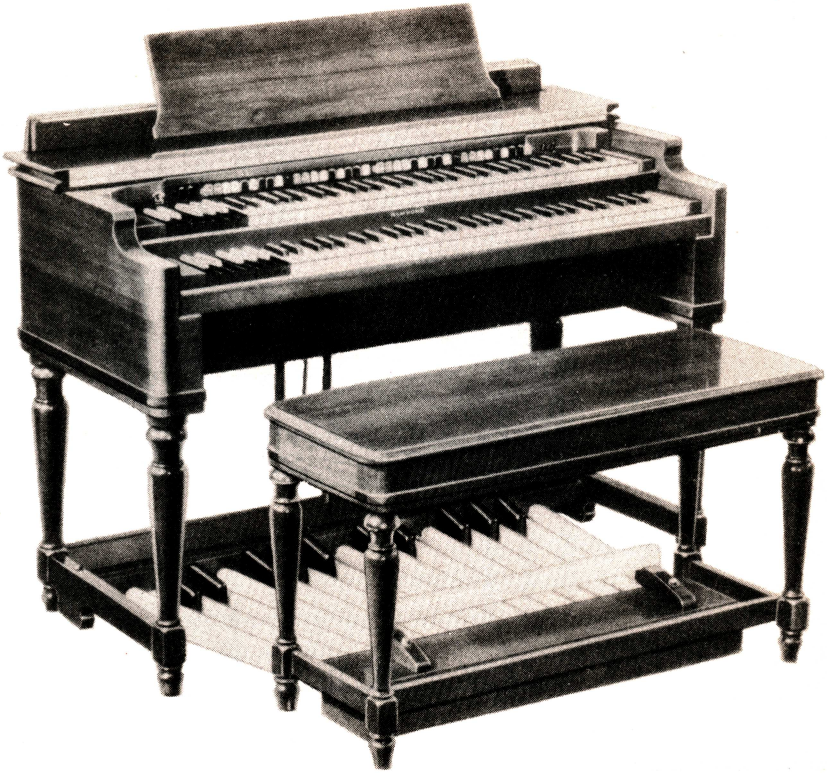
The Hammond Instrument Company
2915 North Western Avenue
Chicago, Illinois

FOREWORD

The Hammond Organ is a product of a company which enjoys a world wide reputation as a manufacturer of precision electrical devices. The manufacturing facilities devoted to the production of the organ are the finest in existence for this type of work. Thus, a background of specialized engineering experience plus modern fabricating methods is behind the Hammond Organ guarantee.

The Hammond Clock Company, in this guarantee, gives the customer assurance that adequate facilities will be available at all times to service the instrument. This manual is designed in the interest of supplying the service technician with all information essential to his rendition of this service. It is designed to serve three purposes: first, to help you make effective installations; second, to guide you in proper maintenance; and third, to instruct you in making repairs if they become necessary.

The Hammond Instrument Company
2915 North Western Avenue
Chicago, Illinois



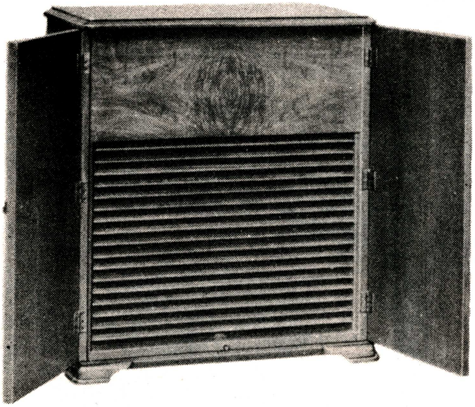
MODEL A CONSOLE 1,193.00

Specifications:

Dimensions: Length, 48" - Width, 24" - Height, 37½".
Finish: American Walnut.
Weight: (without bench and pedal clavier), 275 lbs.
Weight packed: 383 lbs.
Weight of bench: 31 lbs. Weight of pedal clavier: 55 lbs.
Weight packed: 61 lbs. Weight packed: 100 lbs.

Application:

Used with one or more power cabinets. First cabinet connected with 6 conductor console-to-cabinet cable, succeeding cabinets are connected by 3 conductor cable and external power circuits.



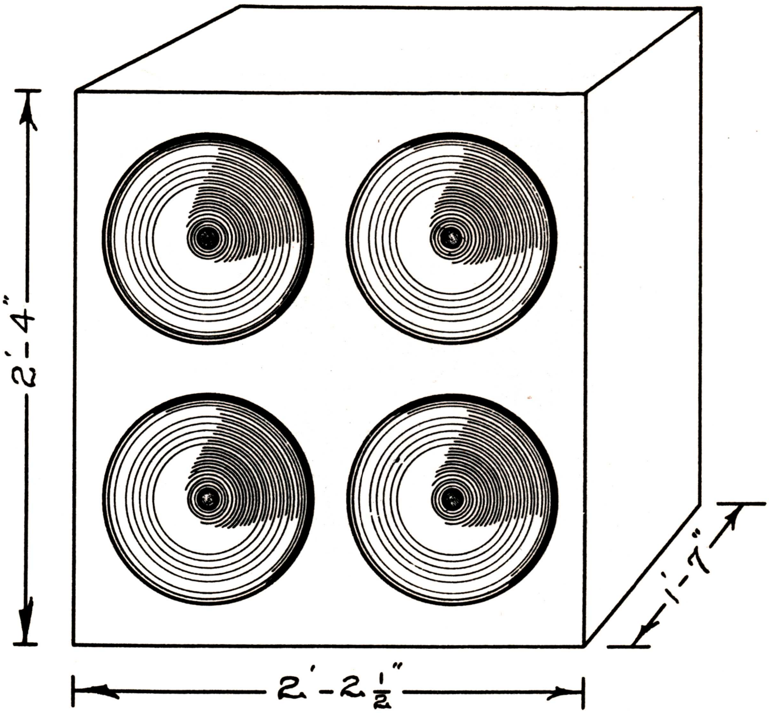
A-20 POWER CABINET

Specifications:

Dimensions: Length, 27" - Width, 15" - Height, 30".
Finish: American Walnut.
Weight: 113 lbs. - Weight packed: 150 lbs.
Output: 20 watts.

Application:

This small decorative power cabinet employs one power amplifier and a pair of 12" dynamic speakers. It is used for homes, mortuaries and small churches, seating not over about 100 people, where a limited amount of power is required.



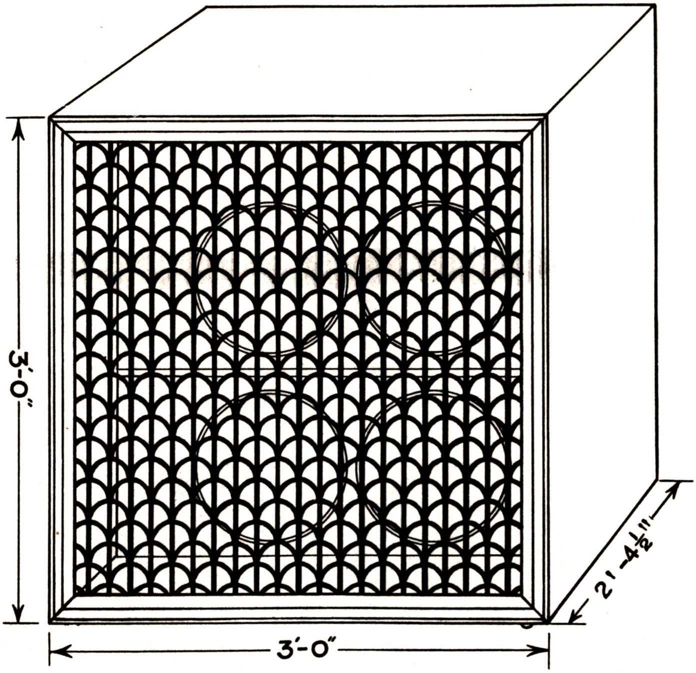
A-40 POWER CABINET 225.00

Specifications:

Dimensions: Length, 26½" - Width, 19" - Height, 28".
Finish: Black lacquer.
Weight: 155 lbs. - Weight packed: 202 lbs.
Output: 40 watts.

Application:

A non-decorative double-strength cabinet designed for use in banks of four or more in large installations where the cabinets are concealed. Two amplifiers and four speakers are used.



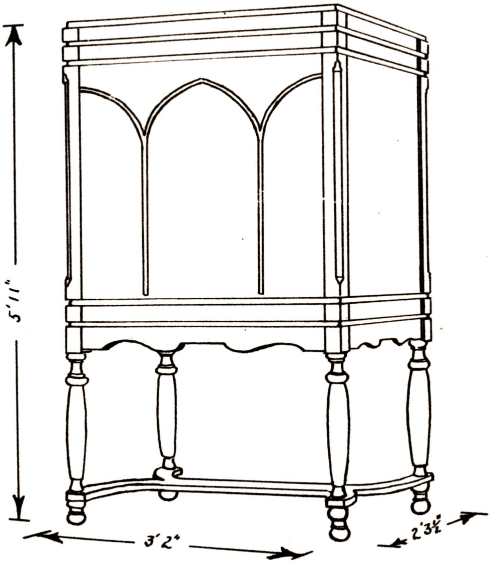
B-40 POWER CABINET 247.00

Specifications:

Dimensions: Length, 36" - Width, 28½" - Height, 36".
Finish: Walnut stain.
Weight: 225 lbs. - Weight packed: 270 lbs.
Output: 40 watts.

Application:

A semi-decorative double-strength cabinet designed for use individually or in groups. The B-40 is found desirable for most churches and for large installations, for it may be used appropriately in almost any setting. Two power amplifiers and four speakers are used.



C-40 TONE CABINET

Specification:

Dimensions: Length, 3' 2" - Width, 2' 3½" - Height, 5' 11".
Finish: Walnut stain.
Weight: 313 lbs. - Weight packed: 401 lbs.
Output: 40 watts.

Application:

The C-40 cabinet has a wide variety of applications. It is especially adapted for use in enclosures which are acoustically "dead". In such enclosures the ceiling or floor is probably the only "live" or reflecting surface available. This type cabinet uses these horizontal surfaces for reflecting purposes. The C-40 cabinet is used individually or in groups of two or more.

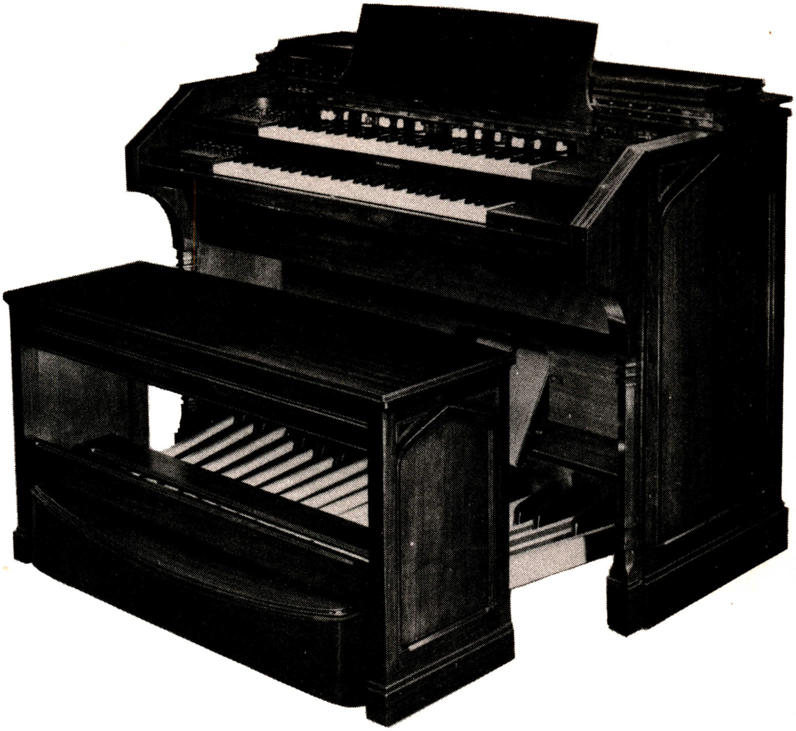
MODEL B CONSOLE 1,342.00

Specifications:

Dimensions: Length, 48" - Width, 29" - Height, 37½"
Finish: American Walnut
Weight: (without bench and pedal clavier), 341 lbs.
Weight packed: 451 lbs.
  Weight of bench: 31 lbs. Weight of pedal clavier: 55 lbs.
  Weight packed: 61 lbs. Weight packed: 100 lbs.

Application:

Differs from Model A only in that it is equipped with chorus generator for optional use. May be connected to one or more standard power cabinets, using 6 conductor cable to the first cabinet and 3 conductor cable and external power circuits for additional cabinets.



MODEL "E" CONSOLE 1,980.00

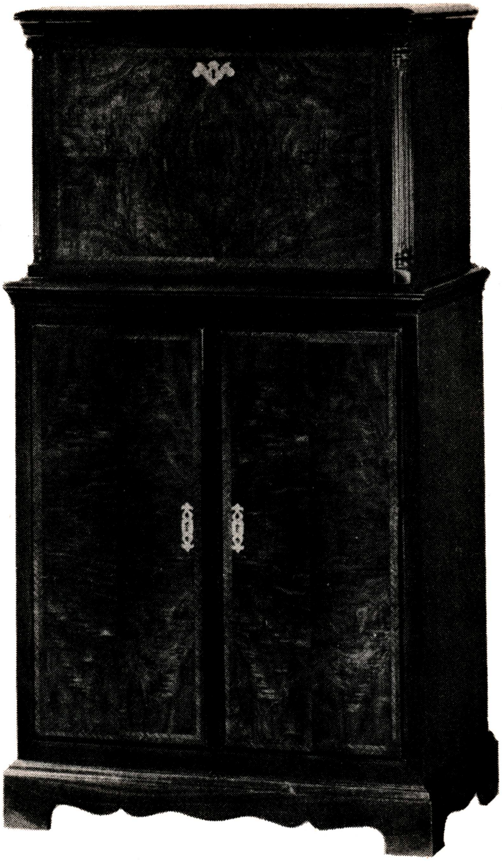
Specifications:

Dimensions: Closed, without pedal clavier--
Width, 57" - Depth, 29" - Height, 40".
Open, with bench and pedal clavier--
Width, 57" - Depth, 47 5/8" - Height, 47".
Finish: American Walnut.
Weight: (without bench and pedal clavier) 423 lbs.
Weight packed: 559 lbs.

Weight of bench: 46 lbs.	Weight packed: 100 lbs.
Weight of pedal clavier: 88 lbs.	Weight packed: 151 lbs.

Application:

Tonally identical with the Model B but designed for needs of professional concert organists. Features concave and radiating 32-note pedal board, separate expression pedals--one for the Swell manual and one for the Great and pedals--separate manual tremulants, pedal toe pistons, Great to Pedal 8' coupler and labeled pre-set pistons. May be connected to one or more standard Hammond tone cabinets in same manner as Model B.



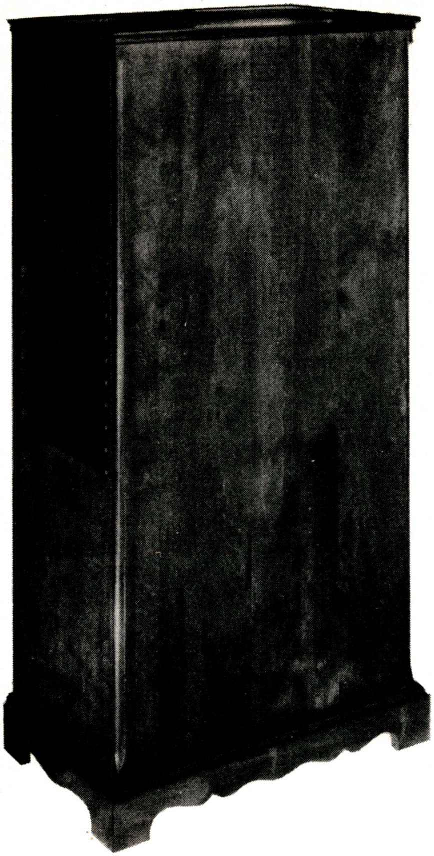
C-20 TONE CABINET 270.00

Specifications:

Dimensions: Width, 29" - Depth, 18 1/4" - Height, 53".
Finish: Matched American Butt Walnut and antique brass hardware.
Weight: 153 lbs. - Weight packed: 198 lbs.
Output: 20 watts.

Application:

Designed for vertical tone projection so as to obtain proper tone diffusion in enclosures which are acoustically "dead." The C-20 is a beautiful piece of furniture appropriate for use in the finest home.



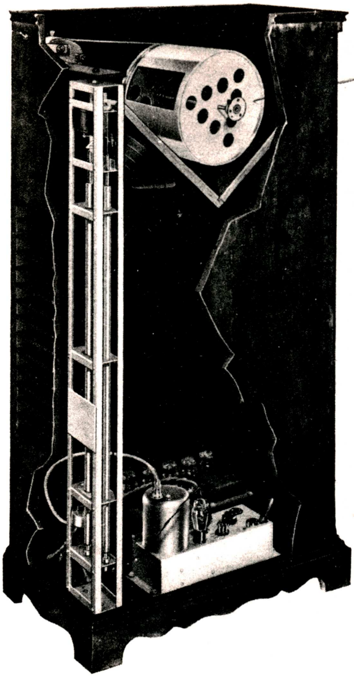
D-20 TONE CABINET 181.00

Specifications:

Dimensions: Width, 28" - Depth, 16 3/4" - Height, 56".
Finish: Face and sides of American Walnut.
Weight: 145 lbs. - Weight packed: 190 lbs.
Output: 20 watts.

Application:

Tonally identical with the C-20, the D-20 fills a need for an inexpensive cabinet for use in a wide variety of installations where decorative qualities are a secondary consideration. May be used alone or in groups of two or more.



Rollator Discontinued

DXR-20 TONE CABINET

TONE CABINETS WITH REVERBERATION CONTROL

319.00

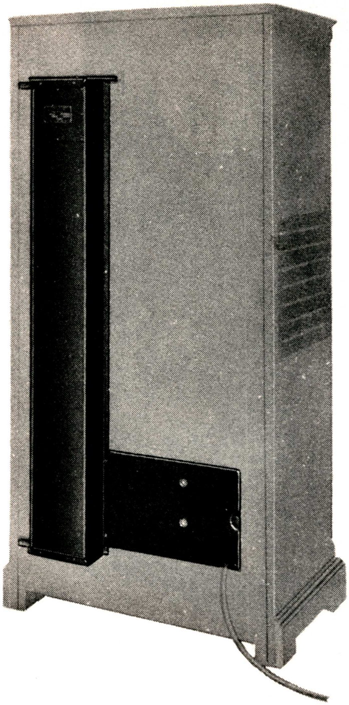
Specifications

DX-20 and DXR-20 Cabinets
Dimensions: Width, 28" - Depth, 16 3/4" - Height, 56"
Weight DR-20 Cabinet: 164 lbs. Weight packed, 231 lbs.
" DXR-20 Cabinet: 178 lbs. " packed, 245 lbs.

CR-20 and CXR-20 Cabinets
Dimensions: Width, 29" - Depth, 18 1/4" - Height, 53"
Weight CR-20 Cabinet: 172 lbs. Weight packed, 236 lbs.
" CXR-20 Cabinet: 186 lbs. " packed, 250 lbs.

Application

Identical with tone cabinets not having the prefix R except that a reverberation control unit is included which supplies electrically the reverberation which is usually present in a large, acoustically "live" enclosure. The R type cabinets are especially useful in enclosures which do not have sufficient natural reverberation for best musical results. Only one R type cabinet is required to furnish reverberation control for any number of tone cabinets.



Kit 137.00

REVERBERATION CONTROL ATTACHMENT

148.00

Shown attached to D-20 or DX-20 tone cabinet.

Weight: 35 lbs. Weight packed: 60 lbs.

Application

The reverberation control attachment is designed for installation on all D-20 115 or 230 volt tone cabinets serial numbered below 7725, DX-20 115 or 230 volt 50 cycle tone cabinets serial numbered below 7460 and DX-20 115 or 230 volt 60 cycle cabinets below 7978. The attachment may also be used in conjunction with any Hammond tone cabinet as described in Part 5 H of the Service Manual. Only one reverberation control attachment is required to furnish reverberation control for any number of tone cabinets.

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART I

General Description of Operating and Construction Details

HAMMOND INSTRUMENT COMPANY
2915 North Western Avenue
Chicago, Illinois

Revised 11.24.41

THEORY OF OPERATION

When a body is set into vibratory motion, the air particles adjacent to it take on a like motion. This motion is transmitted as alternate condensations and rarefactions through the air and exerts a pressure on any object in the path. When the ear drum is presented to this pressure, the ear drum is set in motion and through the auditory mechanism a sensation of sound is perceived by the listener.

The term "sound wave" is given to a train of such condensations and rarefactions. The wave is described as having frequency, magnitude, and wave shape or form.

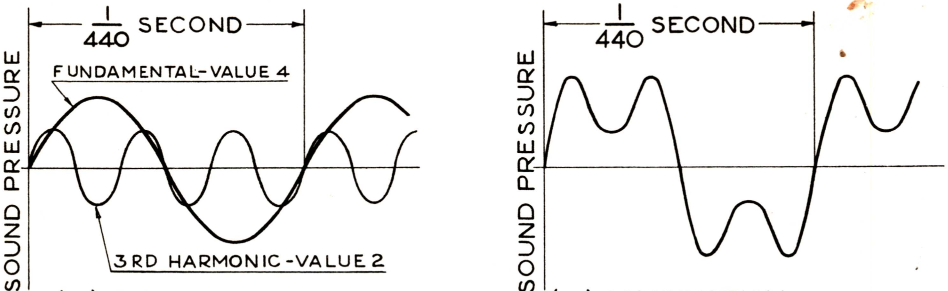
The frequency of a given wave motion may be taken as the number of condensations or rarefactions that arrive per second at a point of reference. In other words, it is the number of complete cycles of condensation-rarefaction in a second. The frequency of a sound determines what is known as the pitch of the sound.

The magnitude of a sound wave may be taken as the maximum pressure exerted at a point of reference by the sound wave. The magnitude of the wave determines the intensity of the sound.

The wave shape may be taken as a graphical representation of variations with time of the pressure at a point of reference. These variations may be very simple or very complex and the wave shape is consequently described as simple or complex. The wave shape of a musical tone will be different for each quality or tone color.

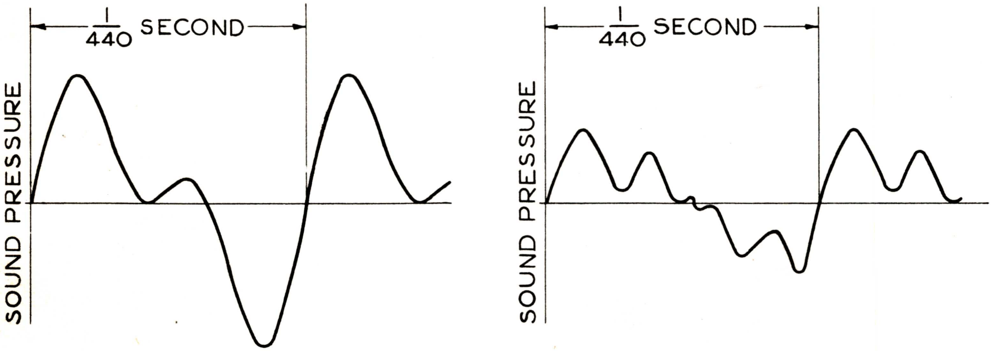
The most simple of wave forms is that in which the pressure varies as the sine function of an angle. This is called a sine wave.

The sound sensation produced by such a sinusoidal pressure variation may be likened to the tone from a gently struck tuning fork. This tone is generally described as a pure or simple tone. However, the majority of musical sounds are not of this simple character. Instead, they are composed of a combination of simple tones, the frequencies of which are multiples of one known as the fundamental, and the intensities of which bear some definite relation to that of the fundamental. It follows then that any complex musical sound may be broken down into a fundamental and a series of multiples or harmonics of this fundamental. Conversely, any complex musical sound may be built up, or synthesised, by properly combining the number and intensities of the various harmonics with the fundamental.


1/440 SECOND
SOUND PRESSURE
FUNDAMENTAL-VALUE 4
3RD HARMONIC-VALUE 2
1/440 SECOND
SOUND PRESSURE

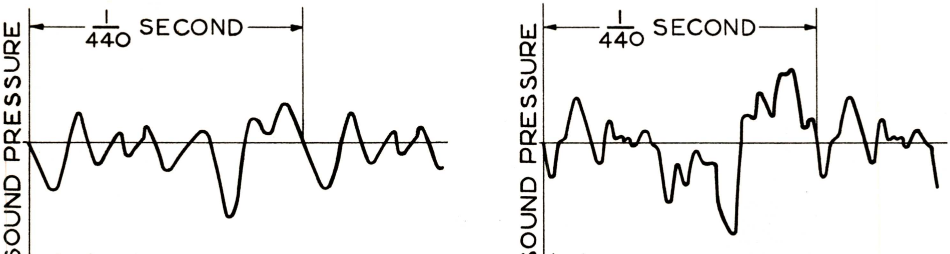
(A) FUND. & 3RD. HARMONIC

(B) COMBINATION 004020000


1/440 SECOND
SOUND PRESSURE
1/440 SECOND
SOUND PRESSURE

(C) FLUTE 007400000 NOTE A "440"

(D) DIAPASON 006444333 NOTE A "440"


1/440 SECOND
SOUND PRESSURE
1/440 SECOND
SOUND PRESSURE

(E) STRING 001455555 NOTE A "440"

(F) REED 555555555 NOTE A "440"

WAVE PATTERNS
FIGURE 1

Graphically, this process of synthesis is illustrated in Figure 1. In Figure 1A, a 440 cycle wave is shown with its third harmonic (1320 cycle) wave of an amplitude equal to half of the fundamental. Figure 4B shows the wave form resulting from the combination--entirely different from either component. With the addition of more harmonics, the wave form becomes more complex as shown by Figures 1C, 1D, 1E and 1F.

In the Hammond Organ a tone generator produces electrical alternating currents whose frequencies correspond with the consecutive pitches of the musical scale and whose wave forms are sinusoidal. These are so connected that there are nine harmonics available for each note on the keyboard. The intensity of each harmonic is separately selected by means of one of the harmonic controller drawbars. In this way, practically any wave shape can be created by the artist and a myriad of qualities of tone produced.

The electrical wave produced by the tone generator is amplified by vacuum tubes and fed into electro-dynamic loud speakers, where it is translated into sound. It should be noted that there is no sound actually produced except in the loud speakers, and that before reaching the speakers the tones are present only as electrical waves.

It is interesting to note that the phase relation of the component wave need not be considered in producing musical tones. If the third harmonic wave in Figure 1A, for instance, were moved along its axis one-fourth or one-half a cycle, the resulting wave shape would be considerably different, but it would sound exactly like the wave of Figure 1B.

OPERATION OF THE ORGAN

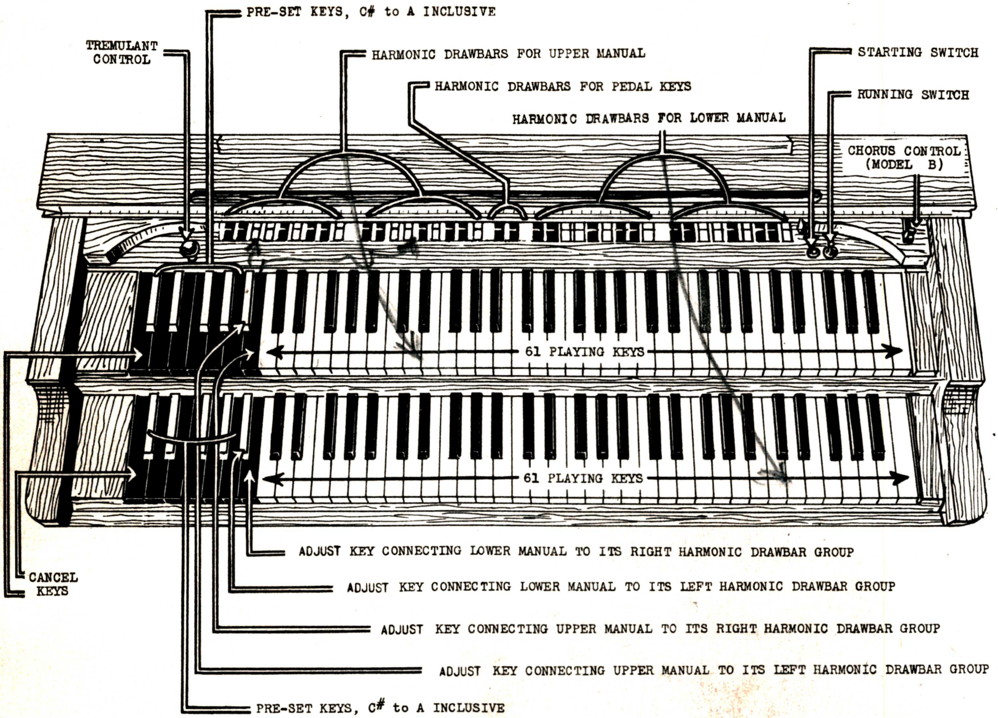
MODEL A CONSOLE

The Hammond Organ Console contains two manuals (see Figure 2), each with 61 playing keys, and a pedal clavier having 25 playing keys (see Figure 3).

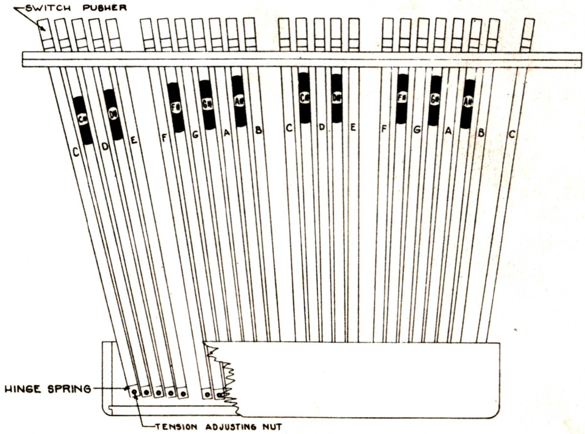
At the left end of each manual are twelve keys identical in form with the playing keys but of opposite color. These are the preset keys and are used to select various tone colors, some of which are "ready mixed" and some adjustable by the organist at the console by means of the harmonic drawbars located above the manuals (see Figure 4).

A knob at the left and above the manuals controls the degree of tremolo as desired by the organist.

An expression or swell pedal located within easy reach of the organist's right foot controls the volume of the instrument.


PRE-SET KEYS, C# to A INCLUSIVE
TREMULANT CONTROL
HARMONIC DRAWBARS FOR UPPER MANUAL
HARMONIC DRAWBARS FOR PEDAL KEYS
HARMONIC DRAWBARS FOR LOWER MANUAL
STARTING SWITCH
RUNNING SWITCH
CHORUS CONTROL (MODEL B)
61 PLAYING KEYS
61 PLAYING KEYS
CANCEL KEYS
ADJUST KEY CONNECTING LOWER MANUAL TO ITS RIGHT HARMONIC DRAWBAR GROUP
ADJUST KEY CONNECTING LOWER MANUAL TO ITS LEFT HARMONIC DRAWBAR GROUP
ADJUST KEY CONNECTING UPPER MANUAL TO ITS RIGHT HARMONIC DRAWBAR GROUP
ADJUST KEY CONNECTING UPPER MANUAL TO ITS LEFT HARMONIC DRAWBAR GROUP
PRE-SET KEYS, C# to A INCLUSIVE

KEYBOARD AND CONTROLS
FIGURE 2


SWITCH PUSHER
C#
D#
F#
G#
A#
C#
D#
F#
G#
A#
C
D
E
F
G
A
B
C
D
E
F
G
A
B
C
HINGE SPRING
TENSION ADJUSTING NUT

PEDAL CLAVIER
FIGURE 3

Preset Keys

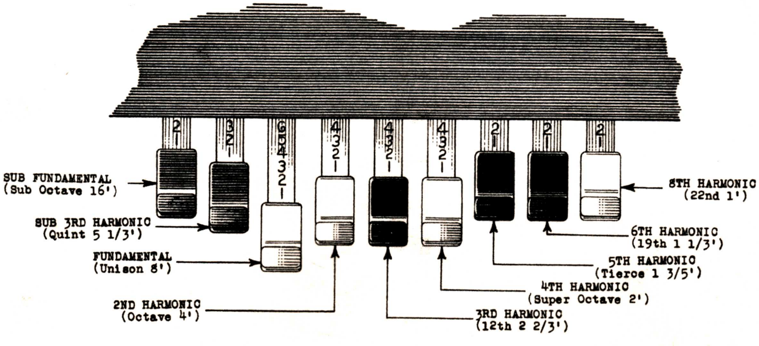
When a preset key is depressed it locks down and is released only when another preset key is depressed. The exception to this is the cancel key, at the extreme left, which serves only to release any other preset key which may be depressed. Only one preset key is used at one time. If by mistake two are depressed and locked they may be released by means of the cancel key.

Each preset key with the exception of the cancel key and the two keys at the extreme right of the group (A# and B keys) makes available a different tone color which has been set up on the preset panel located inside the console. These tone colors are set up at the factory in accordance with a standard design which has been found to best meet the average organist's requirements. They may be changed if desired by removing the back of the console and changing the preset panel connections in accordance with instructions on a card located near the preset panel.

The two preset keys at the extreme right, A# and B, are adjust keys. When A# is depressed, the organ speaks with whatever tone color is set up on the left hand harmonic drawbars associated with that manual. When B is depressed, the organ speaks according to the right hand harmonic drawbars.

Harmonic Drawbars

Figure 4 shows one group of harmonic drawbars, by which the organist is enabled to mix the fundamental and any or all of eight different harmonics in various proportions. The third bar from the left controls the fundamental, and each of the other bars is associated with a separate harmonic. If a drawbar is set all the way in, the harmonic it represents is not present in the mixture.


SUB FUNDAMENTAL
(Sub Octave 16')
SUB 3RD HARMONIC
(Quint 5 1/3')
FUNDAMENTAL
(Unison 8')
2ND HARMONIC
(Octave 4')
3RD HARMONIC
(12th 2 2/3')
4TH HARMONIC
(Super Octave 2')
5TH HARMONIC
(Tierce 1 3/5')
6TH HARMONIC
(19th 1 1/3')
8TH HARMONIC
(22nd 1')
2
1
3
2
1
6
5
4
3
2
1
4
3
2
1
4
3
2
1
4
3
2
1
2
1
2
1
2
1

ONE HARMONIC DRAWBAR GROUP
FIGURE 4

Each drawbar may be set in eight different positions by the organist in addition to the silent position. Each position, as marked on the drawbars, represents a different degree of intensity of the harmonic it controls. When drawn out to position 1, the harmonic it represents will be present with minimum intensity, when drawn out to position 2, with greater intensity, and so on up to position 8.

A tone color is logged by noting the numerical position of the various drawbars. For instance, the tone set up on Figure 2 is known as tone 23 6444 222. After a tone is so logged it may be made available again by setting up the harmonic drawbars to that number.

Harmonic Drawbars for the Pedals

In the pedals the harmonic resources have been combined into only two drawbars. The fundamental (16 foot pitch), second and third harmonics are associated with the left drawbar and produce the fundamental depth to the pedals. The fourth, fifth, sixth and eighth harmonics are associated with the right hand drawbar and produce higher harmonic quality variations. In certain consoles the fundamental and third harmonic only are controlled by the left drawbar, while the second harmonic is included with the higher harmonics controlled by the right hand drawbar.

Vibratto to take place of

Tremulant Control

The organist at the Hammond console may adjust the degree of tremolo to suit his own musical tastes. When the knob (see Figure 2) is turned as far as possible to the left, the tremulant is entirely off. As it is turned to the right (clockwise) the degree of tremolo gradually increases until it reaches the maximum at the extreme right position. The white dot marker on the knob indicates at a glance the degree of tremolo present. The tremulant of the Hammond Organ does not alter the pitch of the tones played, but rather it periodically changes their intensity at a constant rate.

Swell Pedal

The swell pedal is located in the customary position and with it the volume of the organ may be controlled over a wide range. It operates on the two manuals and pedal clavier equally; that is to say, once the manuals and pedals are balanced, they retain their relative balance over the entire swell pedal range.

The dynamic range of the swell unit from fully closed to fully open is 50 decibels. In the most carefully constructed swell shades of other organs, the range seldom exceeds 15 decibels and is usually considerably less. This range would correspond to approximately 32 points on other organs, only very few of which are constructed with a range in excess of 12 points.

Construction and Operation of Various Assemblies

Model A Console

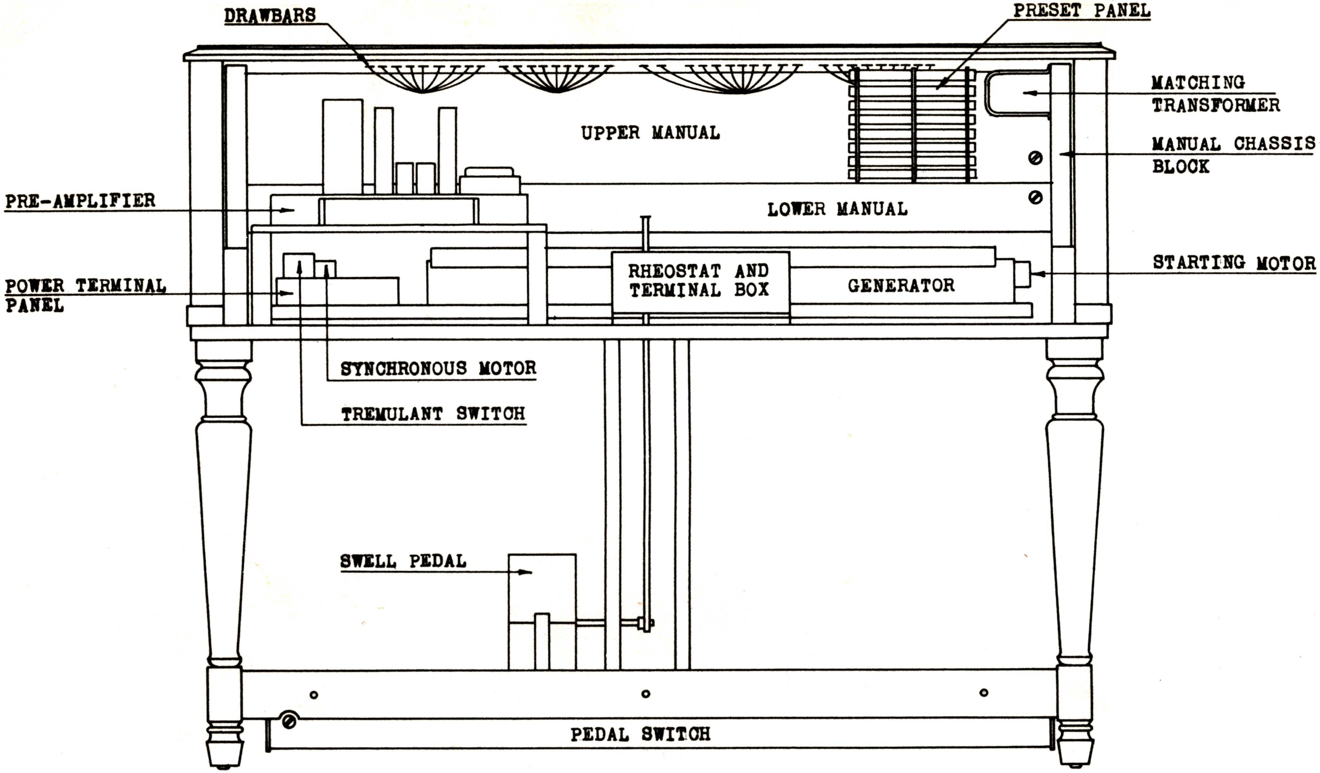
(Model C Console identical except for casework)

In order to give the service technician a clear picture of the construction and operation of the various assemblies of the organ, we have divided the instrument into its major parts and devoted an individual description to each part. By following this discussion carefully, referring to the figures as directed, a good working knowledge of the entire organ may be gained.

The organ console, as illustrated in Figure 5, is made up of the tone generator assembly, the manual chassis assembly, the pedal switch assembly, the rheostat and terminal box assembly, and the pre-amplifier assembly.

In addition to this, the electrical circuit, beginning with the frequencies created in the tone generator and terminating as the input to the pre-amplifier, is described in some detail. It will be worth while to dwell carefully on this part of the discussion (The Electrical Circuit Ahead of the Amplification System) for a clear understanding of it is essential to a thorough knowledge of the operation of the instrument.

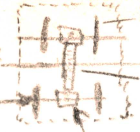
The service technician should also become throughly familiar with the characteristics of the amplification system. A complete description with circuit diagrams is included in section 1-A of the Service Manual.


DRAWBARS
PRESET PANEL
MATCHING TRANSFORMER
UPPER MANUAL
MANUAL CHASSIS BLOCK
PRE-AMPLIFIER
LOWER MANUAL
POWER TERMINAL PANEL
RHEOSTAT AND TERMINAL BOX
GENERATOR
STARTING MOTOR
SYNCHRONOUS MOTOR
TREMULANT SWITCH
SWELL PEDAL
PEDAL SWITCH

MODEL A CONSOLE

REAR VIEW OF CONSOLE WITH BACK REMOVED

FIGURE 5



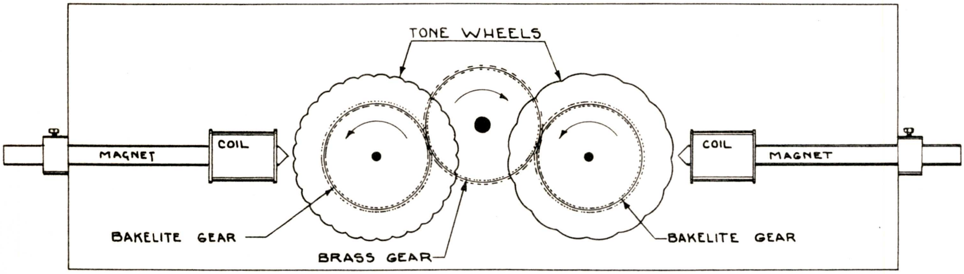
A-Tone Generator

The tone generator assembly consists of the generator proper, an induction motor for starting, a non-self-starting synchronous motor for driving the unit after it is started, and a tremulant switch mechanism mounted on the synchronous motor. The entire assembly is mounted on two long steel angles which are supported in the console by four springs. It is so mounted to minimize the transmission of vibration from the tone generator to the console.

A drive shaft, resiliently coupled to the synchronous running motor, extends the entire length of the generator. Twenty-four brass gears, two each of 12 sizes, are mounted on this shaft, and the drive shaft itself is divided into several sections connected by flexible couplings. The starting motor is mounted at the end of this drive shaft, opposite the synchronous motor.

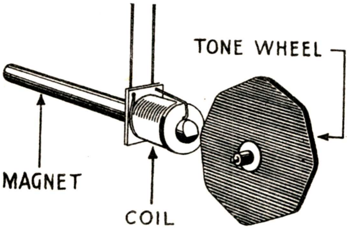
The tone generator proper is a long structure in which are mounted 48 rotating assemblies, each consisting of a shaft and two discs known as tone or phonic wheels. These assemblies are coupled resiliently to the drive shaft. Each of the brass drive gears engages two bakelite gears associated with opposite rotating assemblies. (see Figure 6.) These bakelite gears rotate freely on the shaft with the tone wheels, and are coupled to their respective assemblies by a pair of coil springs. There are 12 sizes of bakelite gears, corresponding to the 12 sizes of brass driving gears. Thus, four of the tone wheels assemblies, each with two tone wheels, run at each of 12 speeds. ?

Each tone wheel is a steel disc about two inches in diameter, accurately machined with a definite number of high and low points on its edge. (See Figure 7.) Each high point on a tone wheel is called a tooth. There are twelve wheels with two teeth, one to operate at each of the twelve speeds; and similarly, twelve have four teeth, twelve have eight, twelve have sixteen, twelve have thirty-two, twelve have sixty-four, twelve have one-hundred-twenty-eight, and seven have one-hundred-ninety-two. An assembly with a two-tooth wheel also has a thirty-two tooth wheel which generates a frequency four octaves above the other. The four and sixty-four tooth wheels also go together, as do the eight and one-hundred-twenty-eight tooth wheels. The twelve sixteen tooth wheels are mounted with seven one-hundred-ninety-two tooth wheels and five blank wheels. The blanks are used merely to maintain the balance of the rotating units, for only 91 frequencies are required for the organ. In this last group the higher frequency is not four octaves above but is four octaves less five semi-tones above the lower.


TONE WHEELS
MAGNET
COIL
COIL
MAGNET
BAKELITE GEAR
BRASS GEAR
BAKELITE GEAR

SECTION OF GENERATOR ASSEMBLY

FIGURE 6


TONE WHEEL
MAGNET
COIL

TONE WHEEL AND MAGNET

FIGURE 7

Each brass gear, with its two bakelite gears and four tone wheels, runs in a separate compartment magnetically shielded from the rest by steel plates which divide the generator into a series of bins. All four tone wheels in any one compartment run at the same speed.

The individual tone wheel shafts are mounted in bearings made of a special porous bronze known as "compo", and each of these bearings is connected to the oiling system by a cotton thread from the oil trough. Thus, oil from the trough is carried by capillary action to all bearings, penetrating them and lubricating the actual bearing surface. The drive shaft and both motors are lubricated in a similar manner. It is very important that the recommended grade of oil is used regularly, as it is essential to the proper operation of the organ that the generator be well lubricated. If oil of varying grades is used, it is likely that the generator may be sluggish in starting, and in time the threads may gum up and prevent the proper flow of oil.

The two spring couplings on the motor shaft, the flexible couplings between the sections of the drive shaft, and the tone wheel spring couplings all contribute to absorbing variations in motor speed. A synchronous motor does not deliver exactly steady power, but rather operates with a series of pulsations, one each half cycle. If the tone wheels were rigidly coupled to the motor this irregularity would carry extra frequencies into each tone wheel. In addition, any "hunting" is suppressed by the resilient couplings and inertia members of the synchronous motor proper.

Associated with each tone wheel is a magnetized rod about $\frac{1}{4}$" in diameter and four inches in length, with a coil of wire wound near one end (see Figure 7). The tip of the magnet at the coil end is ground to a sharp edge and mounted very near the edge of the tone wheel. Each time a tooth passes this rod it changes the magnetic circuit and induces a cycle of voltage in the coil. The voltage is very small and is of known frequency, determined by the number of teeth and the wheel speed.

Small coils are used on the higher frequency magnets and larger coils on the lower frequencies. It is found that large pole pieces are needed on the low frequency magnets to give good low frequency output, but it is necessary to use smaller ones on the high frequencies to prevent excessive iron losses.

Some of the coil have copper rings mounted on them for the purpose of reducing harmonics. As these are used only on fairly low frequency coils, the eddy current loss in such a ring is small for the fundamental frequency of that coil but high for its harmonics. This has the effect of reducing the relative intensities of any harmonics which may be produced by irregularities in the tone wheels. The wheels are cut so as to give as nearly perfect a sine wave as possible, but the generated voltage seldom reaches that ideal condition, since even a change in the air gap will change the wave form. The tip of each magnet as well as the edge of each tone wheel is coated with lacquer to prevent corrosion, for, should oxidation set in, the change in tooth shape would introduce irregular frequencies.

As a means of eliminating any vagrant harmonics that may be present, there are filters consisting of small transformers and condensers associated with certain frequencies. The transformers have a single tapped winding, and this tap is grounded, so one side, which is connected to the corresponding magnet coil through a condenser, forms a resonant circuit for the fundamental frequency of that coil. This tends to emphasize the fundamental and suppress harmonics.

Transformers and condensers are not used below frequency 44, but a length of resistance wire shunts each generator. Frequencies 44 to 48 have transformers only, while both transformers and condensers are used for frequencies 49 to 91.

Two condenser values are used -.255 mfd. for frequencies 49 to 55 and .105 mfd. for frequencies 55 to 91. The transformers for each frequency have different windings.

Model A consoles serial numbered below 2179 do not have condensers for frequencies 49 to 54 inclusive.

These transformers and condensers are mounted on the top of the tone generator assembly. The transformers are mounted at an angle, thus minimizing interference between them. The cores of the transformers are made of a special high permeability alloy, and the number of laminations used is carefully adjusted for the proper inductance. Red and yellow wires from the magnet coils connect to the transformers and black wires from the transformers to the terminal strip on the generator. There are 96 terminals on this strip, the last five of which are all grounded to the generator frame and serve to ground the manuals and pedals. The other 91 terminals carry the various frequencies arranged from right to left in order of increasing frequency.

In Model A consoles serial numbered 2648 and above, frequencies from 1 to 9 have been omitted from the generator; thus there are only 82 generator terminals numbered, for convenience, from 10 to 91. Similarly, there are only 82 tone wheels and magnets in the generator instead of 91. Blank wheels replace the nine two-tooth tone wheels formerly used to produce frequencies from 1 to 9.

This generator change accompanies a wiring revision in the manual and pedal switches which make the frequencies from 1 to 9 unnecessary.

Generators having but 82 frequencies are easily identified by a blank space on the terminal strip at the left of the ground terminals. The first terminal at the left of this space is terminal number 10.

This change in generator construction is also effective in other Hammond consoles serial numbered as follows;

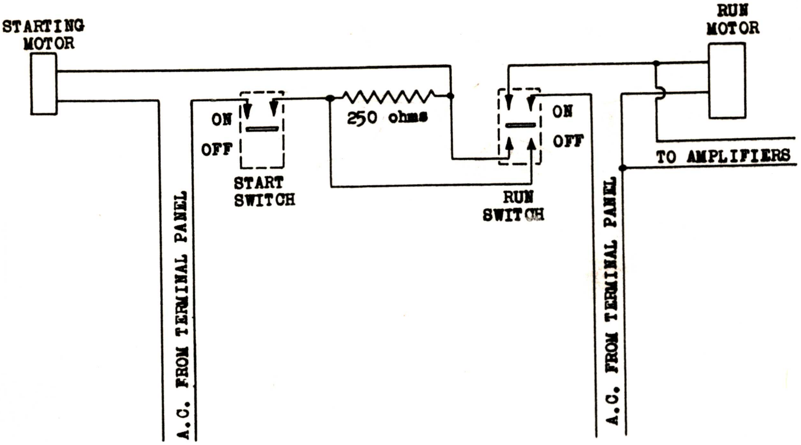
Model B #10550 and above   Model C #1277 and above
Model D #3144 and above   Model E #8664 and above
Player consoles #9210 and above.

B- Generator Start and Run Motors

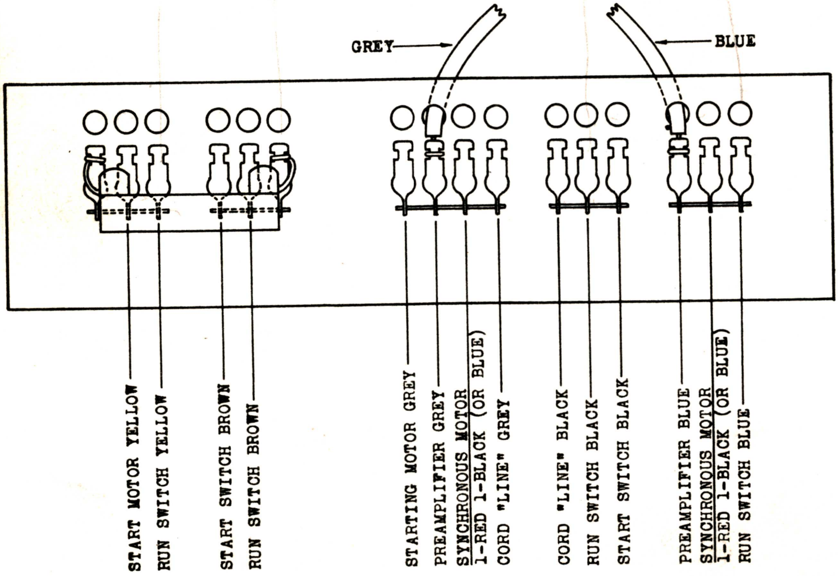
A shaded pole induction motor is used for starting the generator and is located at the right end of the generator as you look in from the back. The rotor of this motor will slide endwise when current is supplied, engage a pinion on its shaft with a gear on the generator driving shaft, and bring the tone generator up to slightly greater than synchronous speed. The synchronous, or run motor, used on 60 cycle current has a two pole field and a six pole armature, and thus a synchronous speed of 1200 r.p.m.

When the organ is started, the starting switch is turned on and held for about eight seconds while the starting motor brings the system up to speed (see Figure 8.) The running switch is then turned on. This switch simultaneously connects the synchronous motor and introduces a 250 ohm resistor in series with the starting motor, thus reducing its driving power. With a braking action of the synchronous motor and a loss of power of the starting motor, the system slows down to synchronous speed and the synchronous motor begins to carry the load. A period of about eight seconds should be allowed for this to take place, after which both switches may be released. The starting switch springs back to the off position and turns off the starting motor, which is disengaged from the rotating shaft by a spring. Figure 8 shows the wiring of the motor control circuits and Figure 9 shows the connections to the power terminal panel.

It should be noted that the synchronous motor does not supply any power except at synchronous speed. Therefore, if for any reason (such as excessive friction, unusually viscous oil, or insufficient starting time) the system fails to reach synchronous speed, it will not continue to run after the starting switch is released. Increased viscosity of the oil caused by low temperatures may therefore necessitate an increase in starting time.


STARTING MOTOR
RUN MOTOR
ON
OFF
250 ohms
START SWITCH
ON
OFF
RUN SWITCH
TO AMPLIFIERS
A.C. FROM TERMINAL PANEL
A.C. FROM TERMINAL PANEL

MODEL A CONSOLE
SWITCH AND MOTOR CIRCUITS
FIGURE 8


GREY
BLUE
START MOTOR YELLOW
RUN SWITCH YELLOW
START SWITCH BROWN
RUN SWITCH BROWN
STARTING MOTOR GREY
PREAMPLIFIER GREY
SYNCHRONOUS MOTOR
1-RED 1-BLACK (OR BLUE)
CORD "LINE" GREY
CORD "LINE" BLACK
RUN SWITCH BLACK
START SWITCH BLACK
PREAMPLIFIER BLUE
SYNCHRONOUS MOTOR
1-RED 1-BLACK (OR BLUE)
RUN SWITCH BLUE

POWER TERMINAL PANEL
FIGURE 9

C- Tremulant Switch and Control

The tremulant switch, mounted on the synchronous motor at the extreme left end of the tone generator, is in effect a variable resistor with no sliding or rubbing contacts. It consists of an eccentric, geared to the motor shaft, which advances a laminated bakelite strip so as to alternately make and break six contacts in order. Five resistors are connected to these contacts, ranging in value from 15,000 to 450,000 ohms, together with a length of copper wire of very little resistance. At one extreme position of the eccentric all contacts are broken and the circuit is open. At the other extreme all contacts are closed and there is practically no resistance in the circuit.

The tremulant control, a 130,000 ohm variable resistor, mounted on the manual chassis assembly, is in parallel with the tremulant switch. When this control is turned to a position of no resistance, the tremulant switch is shorted out. Conversely, when the control is turned to its maximum resistance, the movement of the eccentric varies the resistance of the circuit periodically from 0 to 130,000 ohms. This parallel circuit is in series with the signal from the console, ahead of the pre-amplifier. Therefore, the signal is varied during each revolution of the eccentric by an amount depending upon the adjustment of the tremulant control.

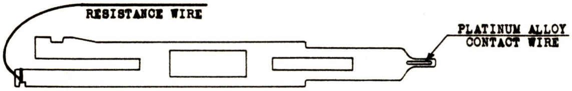
It should be noted that the tremulant switch changes only the intensity of the sound,not its pitch. In addition, since the switch is geared to the driving motor, and does not vary in speed, the change in intensity takes place at a constant frequency.

D- Manual Chassis Assembly

The manual chassis assembly has a terminal strip under each manual made up of 91 terminals to accommodate the frequencies from the tone generator assembly. Each manual has 61 playing keys, and 11 preset keys, each of which operates nine small bronze contact springs with platinum alloy points (see Figure 10). These points make contact with nine bus-bars extending the entire length of the manual. The contact surface of the bus-bars is palladium, while the body of the bars is made of nickel steel.

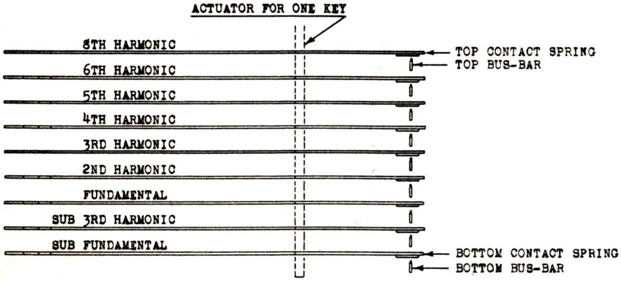
The nine contact springs on each key carry an equal number of harmonics of the particular note with which they are associated (see Figure 11) and are connected by resistance wires to the proper terminals on the terminal strip. Therefore, all key contacts are alive at all times.

When a playing key is pressed, its nine frequencies are impressed on the nine bus-bars of the manual. As there are no wires connected to these bus-bars, a preset or adjust key


RESISTANCE WIRE
PLATINUM ALLOY CONTACT WIRE

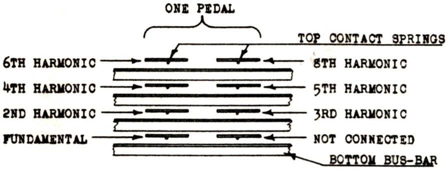
KEY CONTACT SPRING

FIGURE 10.


ACTUATOR FOR ONE KEY
8TH HARMONIC
6TH HARMONIC
5TH HARMONIC
4TH HARMONIC
3RD HARMONIC
2ND HARMONIC
FUNDAMENTAL
SUB 3RD HARMONIC
SUB FUNDAMENTAL
TOP CONTACT SPRING
TOP BUS-BAR
BOTTOM CONTACT SPRING
BOTTOM BUS-BAR

ARRANGEMENT OF MANUAL CONTACTS

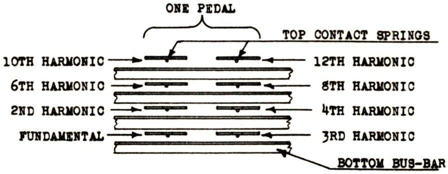
FIGURE 11.


ONE PEDAL
TOP CONTACT SPRINGS
6TH HARMONIC
8TH HARMONIC
4TH HARMONIC
5TH HARMONIC
2ND HARMONIC
3RD HARMONIC
FUNDAMENTAL
NOT CONNECTED
BOTTOM BUS-BAR

ARRANGEMENT OF PEDAL CONTACTS

MODEL A CONSOLES BELOW SERIAL NO.2500
MODEL B CONSOLES BELOW SERIAL NO 5076

FIGURE 12.


ONE PEDAL
TOP CONTACT SPRINGS
10TH HARMONIC
12TH HARMONIC
6TH HARMONIC
8TH HARMONIC
2ND HARMONIC
4TH HARMONIC
FUNDAMENTAL
3RD HARMONIC
BOTTOM BUS-BAR

ARRANGEMENT OF PEDAL CONTACTS

MODEL A CONSOLES SERIAL NO. 2500 AND ABOVE
MODEL B CONSOLES SERIAL NO. 5076 AND ABOVE

FIGURE 13.

must be depressed before any circuit can be completed. Each preset and adjust key has nine contacts exactly like those of the playing keys. These keys have a locking and trip mechanism which allows only one key to be in operation at one time. The key at the extreme left end of the manual is a cancel key and releases any preset or adjust key which happens to be depressed. This cancel key has no contacts.

The adjust keys, A# and B, are connected by flexible wires to the corresponding nine drawbars. These wires are color coded for easy identification. The drawbars make contact with any one of nine bus-bars which are connected to taps on the matching transformer. These bus-bars correspond to different intensities of sound as shown by numbers on the drawbars.

The nine preset keys, from C# to A inclusive, are wired to flexible leads terminating at the preset panel in the back of the console. The preset panel consists of nine bars corresponding to the bus-bars in the drawbar assembly and connected to the same taps of the matching transformer. Set screws are provided on each bar so that the flexible leads carrying the various harmonics from the preset keys may be connected through the bars to any desired taps on the matching transformer. The degree of intensity represented by each bar is shown by a number at the end of the bar.

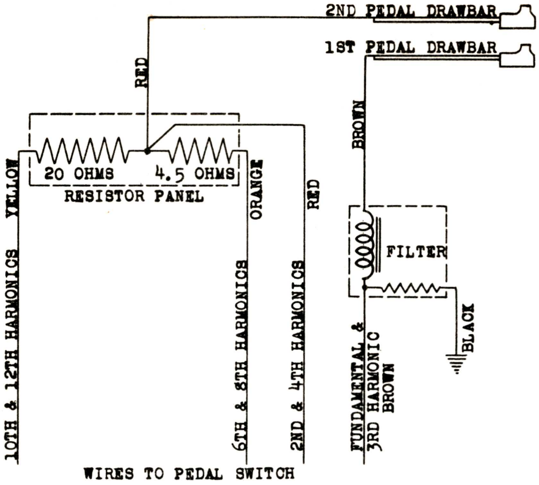
The matching transformer is mounted on the manual chassis assembly and a shielded wire carries the signal from the secondary of this transformer to the rheostat box.

E- Pedal Switch Assembly

The pedal switch is similar in construction to the manuals, except that only four bus-bars are included instead of nine. Each of the 25 pedals actuates a double set of contact springs, making eight contacts available for each note as shown in Figure 12. One of these contacts is not used; therefore, each note consists of a fundamental and six harmonics, no subharmonics being used. The pedal contact springs are connected to terminals by resistance wires similar to those used in the manual assembly. A cable connects these terminals through a wiring tube to the proper terminals on the generator terminal strip.

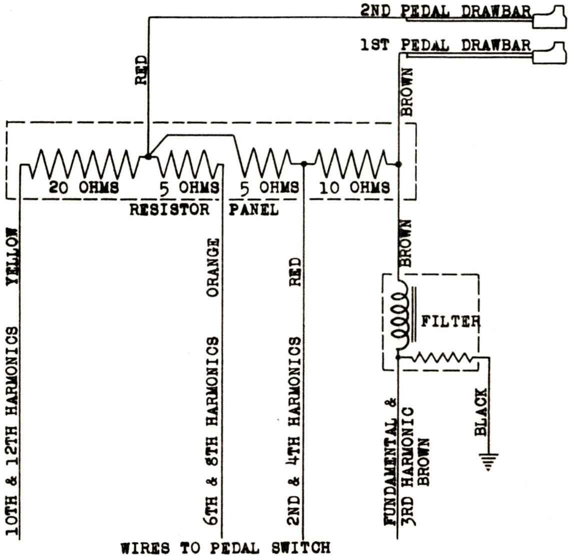
Four colored wires lead from the bus-bars, two to the second pedal drawbar, and the other two to a choke coil and resistor mounted on the manual assembly, and then by means of a single wire to the first pedal drawbar (see Figure 17). The purpose of this choke and resistor is to filter out any higher harmonics which might be present in the lower pedal frequencies.

Model A consoles serial numbered 2500 and above have pedal switches which make use of all eight contacts associated with each pedal. The harmonic system is also different from earlier models as shown in Figure 13.


2ND PEDAL DRAWBAR
1ST PEDAL DRAWBAR
RED
BROWN
20 OHMS
4.5 OHMS
RESISTOR PANEL
YELLOW
ORANGE
RED
FILTER
BLACK
10TH & 12TH HARMONICS
6TH & 8TH HARMONICS
2ND & 4TH HARMONICS
FUNDAMENTAL &
3RD HARMONIC
BROWN
WIRES TO PEDAL SWITCH

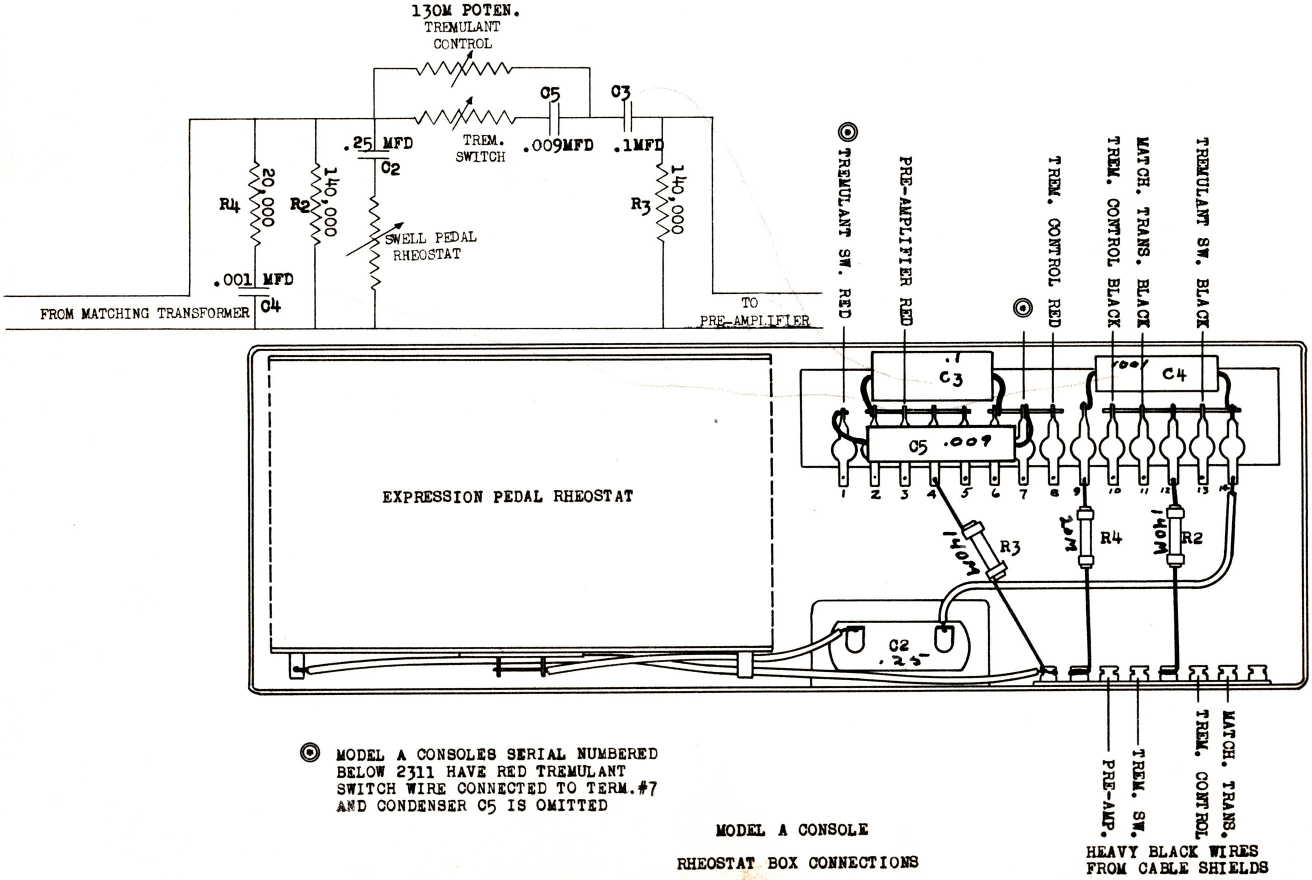
MODEL A CONSOLES SERIAL NO.2500 TO 2647 , MODEL C CONSOLES BELOW NO.1277
MODEL B CONSOLES SERIAL NO.5076 TO 10549, MODEL D CONSOLES BELOW NO.3144

WIRING TO PEDAL DRAWBARS
FIGURE 14.


2ND PEDAL DRAWBAR
1ST PEDAL DRAWBAR
RED
BROWN
20 OHMS
5 OHMS
5 OHMS
10 OHMS
RESISTOR PANEL
BROWN
YELLOW
ORANGE
RED
FILTER
BLACK
10TH & 12TH HARMONICS
6TH & 8TH HARMONICS
2ND & 4TH HARMONICS
FUNDAMENTAL &
3RD HARMONIC
BROWN
WIRES TO PEDAL SWITCH

MODEL A CONSOLES SERIAL #2648 & ABOVE, MODEL C CONSOLES SERIAL #1277 & ABOVE
MODEL B CONSOLES SERIAL #10550 & ABOVE, MODEL D CONSOLES SERIAL #3144 & ABOVE

WIRING TO PEDAL DRAWBARS
FIGURE 15.


130M POTEN.
TREMULANT CONTROL
C5
C3
.25 MFD
C2
TREM. SWITCH
.009MFD
.1MFD
R4
20,000
R2
140,000
R3
140,000
SWELL PEDAL RHEOSTAT
.001 MFD
C4
FROM MATCHING TRANSFORMER
TO PRE-AMPLIFIER
TREMULANT SW. RED
PRE-AMPLIFIER RED
TREM. CONTROL RED
TREM. CONTROL BLACK
MATCH. TRANS. BLACK
TREMULANT SW. BLACK
.1
C3
.001
C4
C5 .009
1
2
3
4
5
6
7
8
9
10
11
12
13
14
EXPRESSION PEDAL RHEOSTAT
140M
R3
20M
R4
140M
R2
C2
.25
PRE-AMP.
TREM. SW.
TREM. CONTROL
MATCH. TRANS.
HEAVY BLACK WIRES FROM CABLE SHIELDS

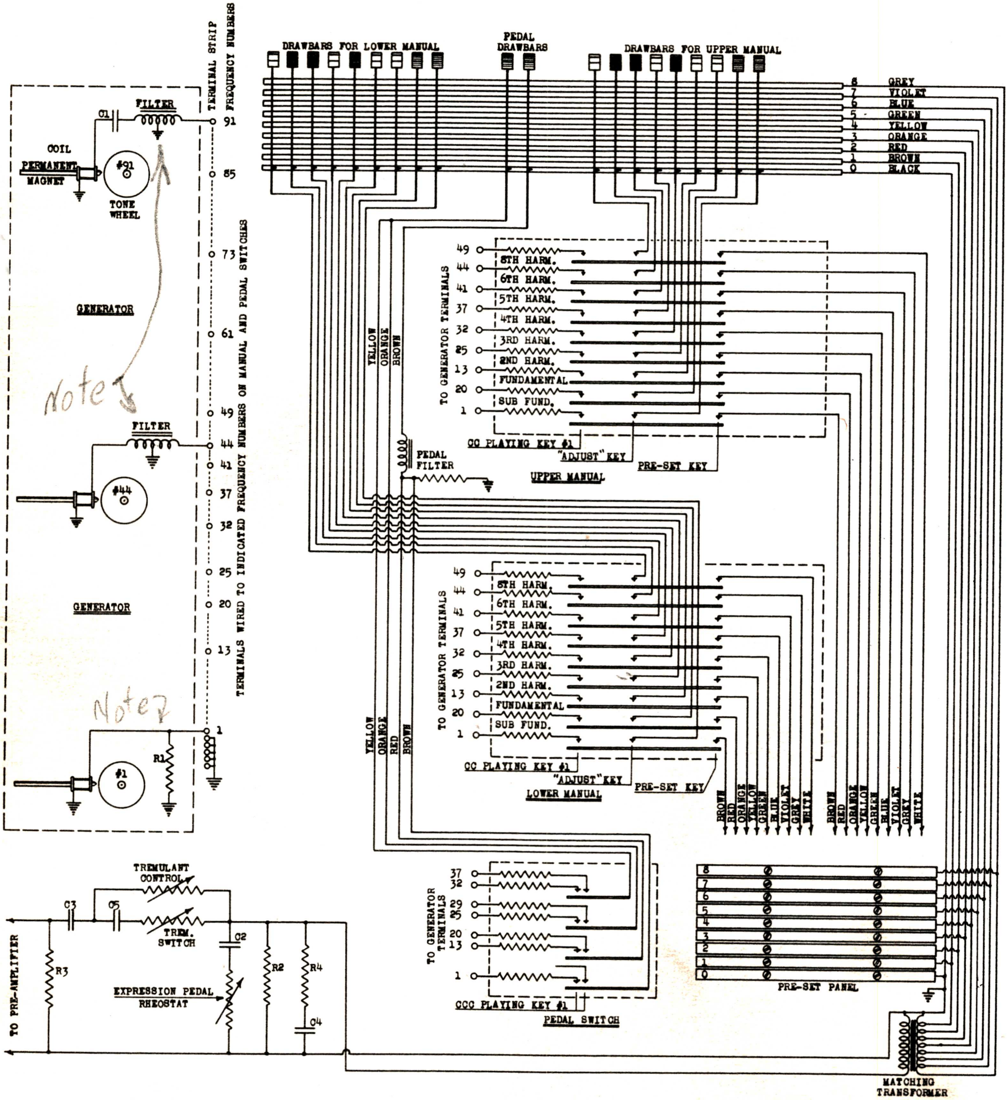
◉ MODEL A CONSOLES SERIAL NUMBERED BELOW 2311 HAVE RED TREMULANT SWITCH WIRE CONNECTED TO TERM.#7 AND CONDENSER C5 IS OMITTED

MODEL A CONSOLE

RHEOSTAT BOX CONNECTIONS

FIGURE 16

3 Typical Tone Gen Illustrated


DRAWBARS FOR LOWER MANUAL
PEDAL DRAWBARS
DRAWBARS FOR UPPER MANUAL
8 GREY
7 VIOLET
6 BLUE
5 GREEN
4 YELLOW
3 ORANGE
2 RED
1 BROWN
0 BLACK
TERMINAL STRIP FREQUENCY NUMBERS
C1
FILTER
COIL
PERMANENT MAGNET
#91
TONE WHEEL
91
85
73
61
49
44
41
37
32
25
20
13
1
GENERATOR
Note 1
FILTER
#44
GENERATOR
Note 2
R1
#1
TERMINALS WIRED TO INDICATED FREQUENCY NUMBERS ON MANUAL AND PEDAL SWITCHES
YELLOW
ORANGE
BROWN
RED
PEDAL FILTER
TO GENERATOR TERMINALS
8TH HARM.
6TH HARM.
5TH HARM.
4TH HARM.
3RD HARM.
2ND HARM.
FUNDAMENTAL
SUB FUND.
CC PLAYING KEY #1
"ADJUST" KEY
PRE-SET KEY
UPPER MANUAL
LOWER MANUAL
BROWN
RED
ORANGE
YELLOW
GREEN
BLUE
VIOLET
GREY
WHITE
TREMULANT CONTROL
C3
C5
TREM. SWITCH
C2
R3
R2
R4
C4
EXPRESSION PEDAL RHEOSTAT
TO PRE-AMPLIFIER
37
32
29
25
20
13
1
CCC PLAYING KEY #1
PEDAL SWITCH
PRE-SET PANEL
MATCHING TRANSFORMER

WIRING DIAGRAM - MODEL A CONSOLE

FIGURE 17

Model A consoles serial numbered 2500 to 2647 have wiring to pedal drawbars as shown in Figure 14.

Model A consoles serial numbered 2648 and above have pedal drawbar wiring as shown in Figure 15.

The pedal clavier itself is detachable and is, in effect, merely a series of levers. (Figure 3 shows its construction.) Switch pusher springs on the ends of the pedals depress small pusher pins which actuate the pedal switch contacts.

F- Rheostat and Terminal Box Assembly

The swell pedal or volume control rheostat is mounted, together with a signal terminal strip, in a metal box near the center of the console. The rheostat is, in effect, a variable resistance with no sliding contacts. When the pedal is advanced a bakelite cam moves down, opening in succession a series of 32 platinum alloy contacts which are connected to fixed carbon resistances. This method of controlling the volume provides smooth operation with no appreciable wear on the contacts.

The signal terminal strip is shown in Figure 16. Four shielded cables from the matching transformer, pre-amplifier, tremulant switch and tremulant control are connected to this strip, as well as several condensers and resistors associated with the signal circuit.

G- The Electrical Circuit Ahead of the Amplification System

The electrical impulses which terminate in millions of beautiful tone qualities of the Hammond Organ originate in many tiny tone generators which comprise the tone generator assembly.

Three typical tone generators are illustrated in Figure 17; See generator number 91, which employs a filter transformer and a condenser; generator 44, which employs a transformer only; and generator number 1, which has no filter circuit but is shunted by resistance, R1. The primary winding of each transformer, with the corresponding condenser and pick-up coil, forms a resonant circuit. A voltage induced in the secondary of the transformer, representative of one of a series of frequencies, is then conveyed to the generator terminal strip.

The circuits of the "CC" playing key on each manual and the "CCC" pedal are shown in Figure 17. The nine contacts on each manual key and the seven contacts on each pedal key are connected by wires of known resistance value to the manual and pedal terminal strips on which the generated frequencies are present. When a key is depressed its nine harmonics are impressed on nine manual bus-bars. Each of these bus-bars carries a particular harmonic from all depressed keys of the manual. A preset key, representing a definite combination of harmonic intensities, must be depressed to complete the circuit of either manual.

The two right-hand preset keys on each manual, designated as adjust keys, are associated with the harmonic drawbars. The nine contacts of these keys are connected to the corresponding nine drawbars. When these drawbars are set to some particular combination, each drawbar is connected to a tap on the matching transformer.

The pedal keys are similarly wired but have no preset switches, the four bus-bars in the pedal switch are connected to two drawbars, the three lower harmonics passing through a choke coil designed to suppress undesirable high frequency mixtures which may be present. The organist, by adjusting the intensity of high and low frequencies with the pedal drawbars, may control the low frequency response of the pedals.

Several resistors and condensers following the matching transformer are located in the rheostat and terminal box, as shown in Figure 16. A resistor R2 forms a constant impedance load on the matching transformer, while R4 and C4 serve to attenuate the higher frequencies. (R4 and C4 are not used in Model A consoles serial numbered below 1231))

The swell pedal rheostat, in series with tone compensating condenser C2, is across the signal line, so that when its resistance is least the volume is least.

The tremulant control, a 130,000 ohm variable resistor, shunts the tremulant switch in order to vary its effect. Condenser C5 which avoids excessive tremolo on the lower bass frequencies, was not originally installed in Model A consoles serial numbers below 2311.

C3 is a blocking condenser, and R5 acts as a grid resistor for the 57 tube in the pre-amplifier.

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 1

OPERATING AND CONSTRUCTION DETAILS

A - The Amplification System

HAMMOND INSTRUMENT COMPANY
2915 N. Western Avenue
Chicago, Illinois

Revised 12/1/41 Printed in U.S.A.

THE AMPLIFICATION SYSTEM

The electrical impulses which produce the tones of the Hammond Organ are given their original amplification by a pre-amplifier located in the console, and are then transmitted to the power amplifiers which are located in the tone cabinets.

Referring to the pre-amplifier circuits which are illustrated in Figures 1 to 8 inclusive, it will be noted that no power transformer is included in the pre-amplifier but that the required plate current is supplied by a power amplifier in the first tone cabinet. This is to eliminate the possibility of an induced hum from the magnetic field of the power transformer being picked up by the input matching transformer.

A tone control is included in the pre-amplifier whereby the relative intensity of the high and low frequencies may be changed to suit acoustical conditions by **varying** the amplitude of the higher frequencies.

A microphone or phonograph pickup may be used with the organ by connecting between posts P and GND on the pre-amplifier terminal panel. This arrangement produces screen modulation at the input tube; however, the impedance of the input device should be less than 500 ohms, otherwise a serious drop in volume of the organ will result. For greater efficiency, it is recommended that any input device be connected to the organ through a suitable pre-amplifier having an output impedance of approximately 200 ohms.

The signal line from the push-pull output transformer in the pre-amplifier to the power amplifiers has a total impedance of approximately 200 ohms and as it is connected directly to the grids of the input tubes of the power amplifier, practically any number of power amplifiers may be connected in parallel without any decrease in the volume or quality of the signal.

Power amplifier circuits are illustrated in Figures 9 and 10. The output transformer of the power amplifier has a secondary impedance of 4 ohms to match the two 8 ohm speaker voice coils in parallel.

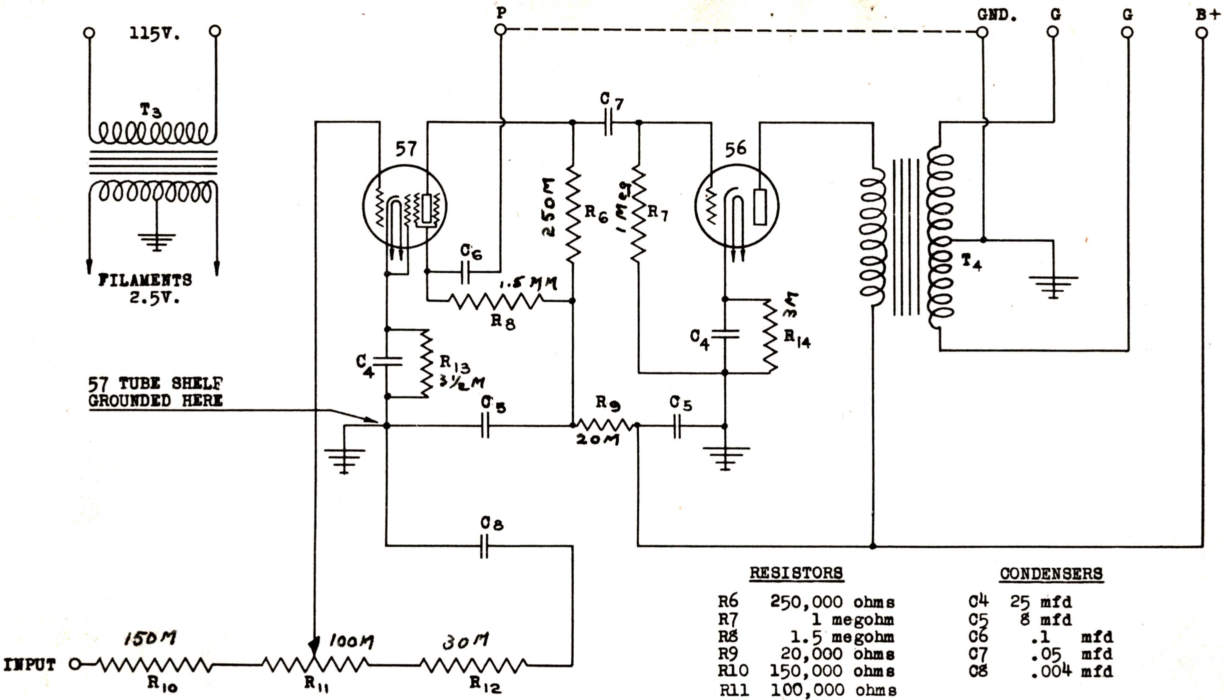
Methods of connecting amplifiers and specifications of cables and plugs used for this purpose are included in Part 3 of the Service Manual.

Replacement parts with the exception of resistors and condensers, which are standard items and may be purchased from a radio supplier, should always be ordered from Hammond Instrument Company. When ordering, the type and serial number of the console or tone cabinet should be specified.

The tubes used in the Hammond organ are of standard type and may be purchased locally. When making replacement, however, tubes of like type in the amplifier should be checked for similar plate current readings. If tubes have been in service for a considerable length of time it is usually advisable to change all tubes at one time rather than to try to match new tubes with tubes which have deteriorated in service.

Note

The reverberation pre-amplifier circuit is illustrated in Figure 11.


115V.
T3
FILAMENTS
2.5V.
P
GND.
G
G
B+
57
56
C7
C6
1.5 MM
R8
250M
R6
1 meg
R7
T4
3M
R14
C4
C4
R13
3½ M
57 TUBE SHELF
GROUNDED HERE
C5
R9
20M
C5
C8
INPUT
150M
R10
100M
R11
30M
R12

RESISTORS

R6	250,000 ohms
R7	1 megohm
R8	1.5 megohm
R9	20,000 ohms
R10	150,000 ohms
R11	100,000 ohms
R12	30,000 ohms
R13	3,500 ohms
R14	3,000 ohms

CONDENSERS

C4	25 mfd
C5	8 mfd
C6	.1 mfd
C7	.05 mfd
C8	.004 mfd

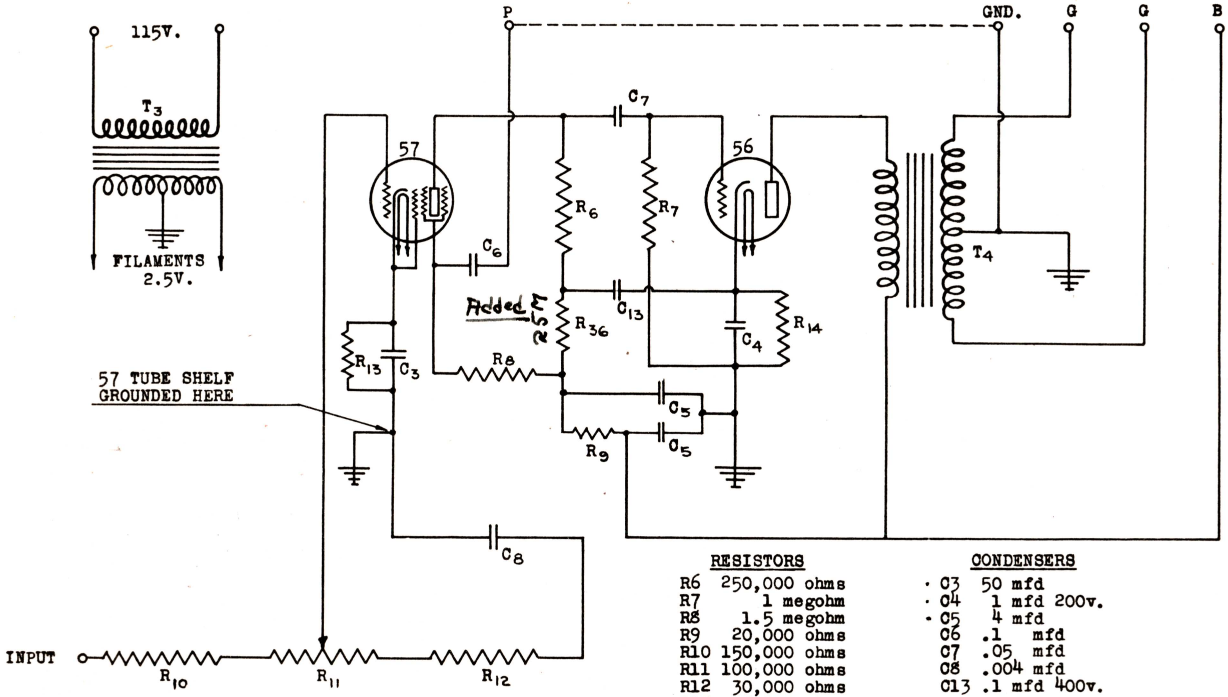
T3	Filament transformer
T4	Output transformer (Primary 1300 ohms) (Secondary 15 ohms)

1A

USED ON MODEL A CONSOLE
SERIAL NO. 1573 & BELOW

PRE-AMPLIFIER

FIGURE 1


115V.
T3
FILAMENTS 2.5V.
57 TUBE SHELF GROUNDED HERE
57
56
P
GND.
G
G
B
C7
C6
C13
C4
C3
C8
C5
C5
R6
R7
R8
R9
R13
R14
R36
Added 25M
T4
INPUT
R10
R11
R12

RESISTORS	
R6	250,000 ohms
R7	1 megohm
R8	1.5 megohm
R9	20,000 ohms
R10	150,000 ohms
R11	100,000 ohms
R12	30,000 ohms
R13	3,500 ohms
R14	3,000 ohms
· R36	25,000 ohms

CONDENSERS	
· C3	50 mfd
· C4	1 mfd 200v.
· C5	4 mfd
C6	.1 mfd
C7	.05 mfd
C8	.004 mfd
C13	.1 mfd 400v.

· Added to Previous

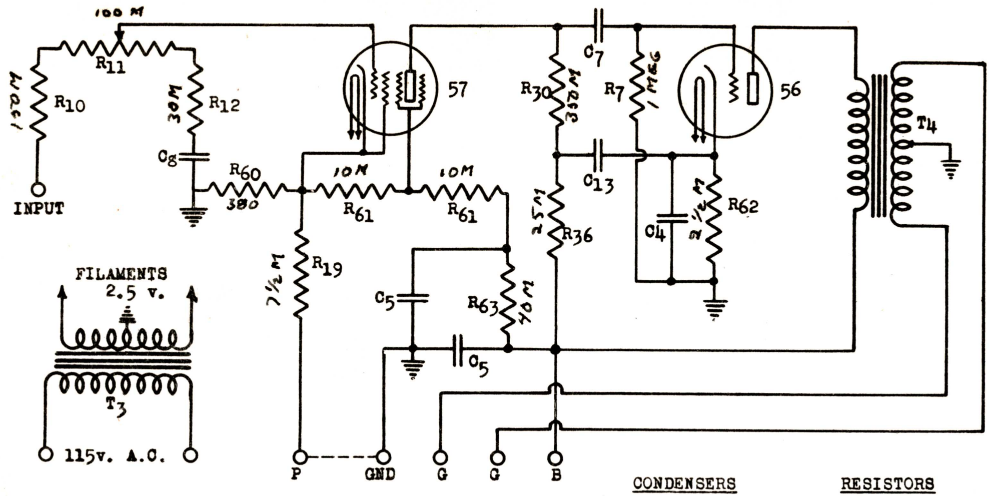
T3	Filament transformer
T4	Output transformer (Primary 1300 ohms) (Secondary 15 ohms)

USED ON MODEL A CONSOLE — A
SERIAL NO.1574 TO 2451 INCL.

USED ON MODEL B CONSOLE — B
SERIAL NO.5539 AND BELOW

-PRE-AMPLIFIER-

FIGURE 2


100 M
R11
150M
R10
30M
R12
C8
INPUT
R60
380
10M
R61
10M
R61
57
7½M
R19
C5
R63
40M
C5
R30
350M
C7
R7
1 MEG
56
C13
25M
R36
C4
2½M
R62
T4
FILAMENTS
2.5 v.
T3
115v. A.C.
P
GND
G
G
B

CONDENSERS

C4	1 mfd	200v.
C5	4 mfd	400v.
C7	.05 mfd	400v.
C8	.004 mfd	200v.
C13	1 mfd	400v.

T3	Filament transformer
T4	Output transformer (Primary 1300 ohms) (Secondary 15 ohms)

RESISTORS

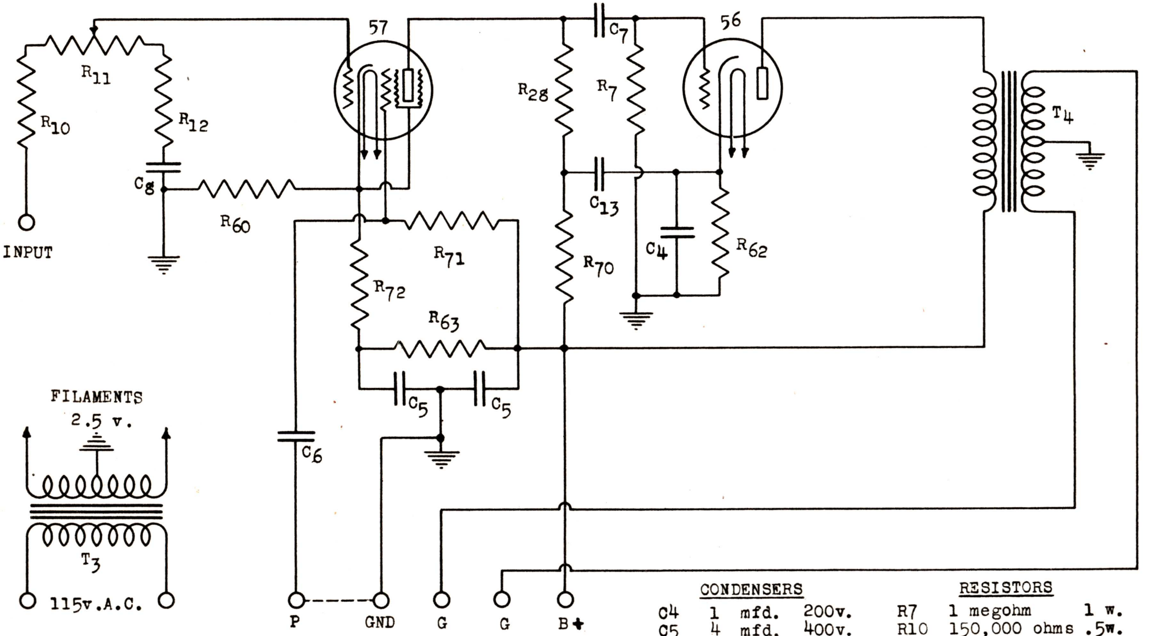
R7	1 megohm
R10	150,000 ohms
R11	100,000 ohms
R12	30,000 ohms
R19	7,500 ohms
R30	350,000 ohms
R36	25,000 ohms
R60	380 ohms
R61	10,000 ohms
R62	2,500 ohms
R63	40,000 ohms

A USED ON MODEL A CONSOLE
SERIAL NO.2452 TO 2559 INCL.

B USED ON MODEL B CONSOLE
SERIAL NO. 5540 TO 5939 INCL.

-PRE-AMPLIFIER-

FIGURE 3


INPUT
R10
R11
R12
C8
R60
57
R72
R71
R63
C5
C5
C6
R28
R7
C7
C13
R70
C4
R62
56
T4
FILAMENTS
2.5 v.
T3
115v.A.C.
P
GND
G
G
B+

CONDENSERS		
C4	1 mfd.	200v.
C5	4 mfd.	400v.
C6	.1 mfd.	400v.
C7	.05 mfd.	400v.
C8	.004 mfd.	200v.
C13	1 mfd	400v.

RESISTORS		
R7	1 megohm	1 w.
R10	150,000 ohms	.5w.
R11	100,000 ohms	
R12	30,000 ohms	.5w.
R28	350,000 ohms	.5w.
R60	380 ohms	1 w.
R62	2,500 ohms	1 w.
R63	40,000 ohms	1 w.
R70	100,000 ohms	.5w.
R71	2 megohms	1 w.
R72	20,000 ohms	1 w.

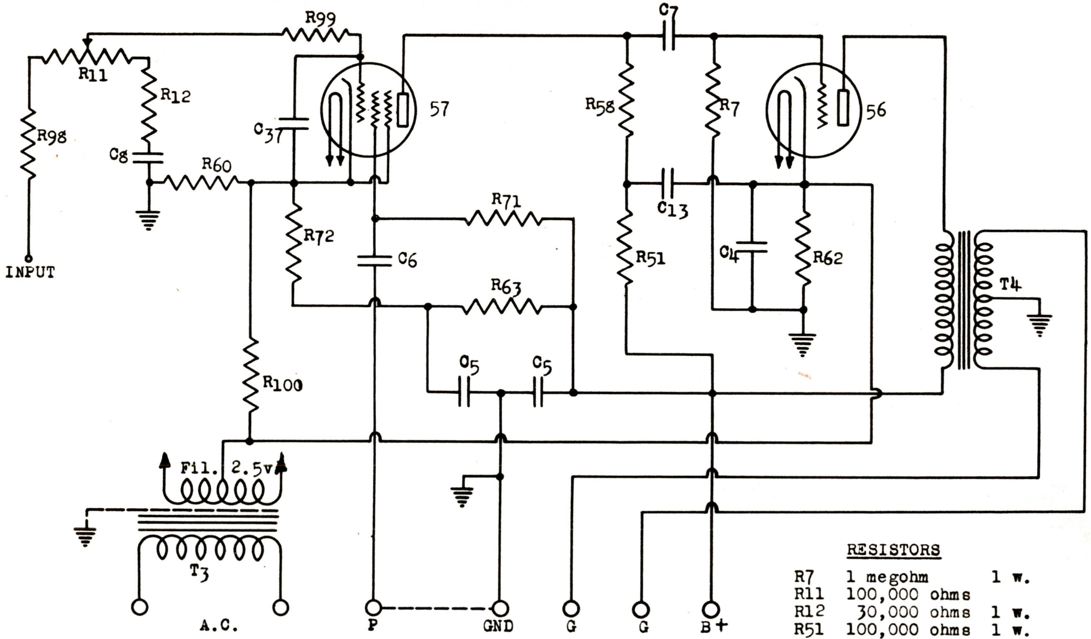
T3 Filament transformer
T4 Output transformer (Primary 1300 ohms) (Secondary 15 ohms)

ABCD

USED IN CONSOLES
MODEL A SERIAL NO.2560 TO 2646 INCL.
MODEL B SERIAL NO.5940 TO 10032 INCL.
MODEL C SERIAL NO.1212 & BELOW.
MODEL D SERIAL NO.1208 & BELOW.
PLAYER SERIAL NO.9123 & BELOW.

-PRE-AMPLIFIER-

FIGURE 4


R99
R11
R12
R98
C8
R60
C37
57
INPUT
R72
C6
R71
R63
R100
C5
C5
Fil. 2.5v
T3
A.C.
P
GND
G
G
B+
C7
R58
R7
56
C13
R51
C4
R62
T4

USED IN CONSOLES
MODEL A SERIAL NO.2647 & ABOVE
MODEL B SERIAL NO.10033 & ABOVE
MODEL C SERIAL NO.1213 & ABOVE
MODEL D SERIAL NO.1809 & ABOVE
PLAYER SERIAL NO.9124 & ABOVE

CONDENSERS

C4	1 mfd	200v.
C5	4 mfd	400v.
C6	.1 mfd	400v.
C7	.05 mfd	400v.
C8	.0035 mfd	200v.
C13	1 mfd	400v.
C37	.0001 mfd	500v.

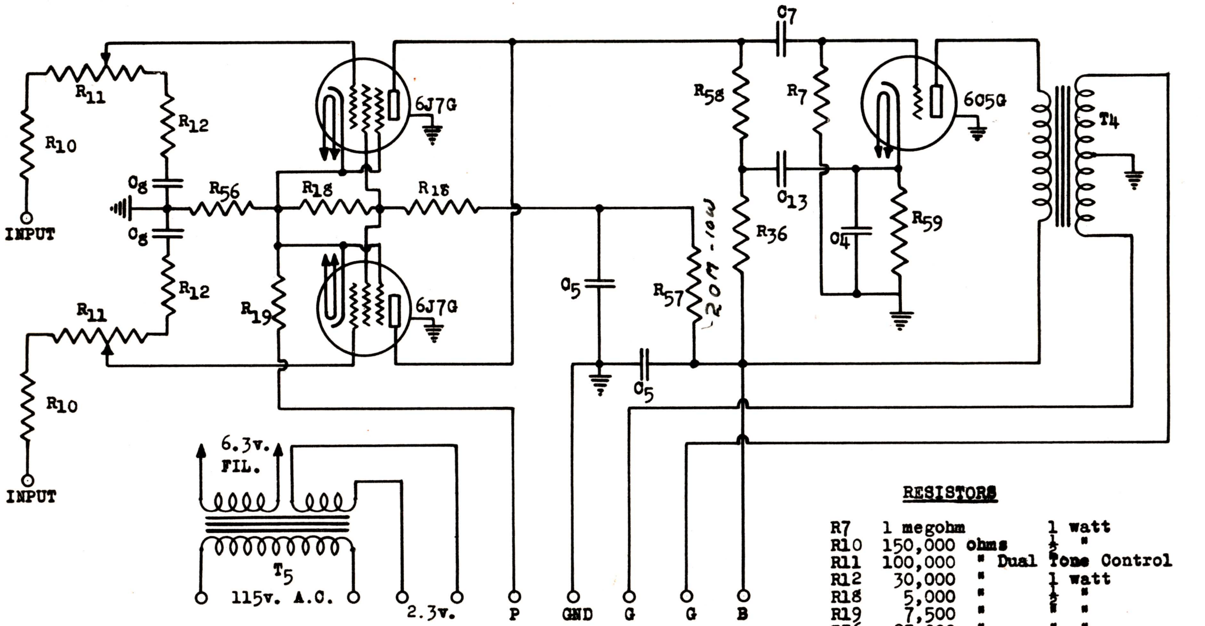
RESISTORS

R7	1 megohm	1 w.
R11	100,000 ohms	
R12	30,000 ohms	1 w.
R51	100,000 ohms	1 w.
R58	350,000 ohms	1 w.
R60	380 ohms	1 w.
R62	2,500 ohms	1 w.
R63	40,000 ohms	1 w.
R71	2 megohms	1 w.
R72	20,000 ohms	1 w.
R98	150,000 ohms	1 w.
R99	50,000 ohms	.3 or .5w.
R100	200,000 ohms	1 w.

T3 Filament transformer
T4 Output transformer

-PRE-AMPLIFIER-

FIGURE 5


INPUT
INPUT
R10
R10
R11
R11
R12
R12
C8
C8
R56
R18
R18
R19
6J7G
6J7G
C5
C5
R57
20M-10W
R58
R7
C7
C13
R36
C4
R59
605G
T4
6.3v.
FIL.
T5
115v. A.C.
2.3v.
P
GND
G
G
B

TRANSFORMERS

T4	Output transformer
T5	Filament Transformer

CONDENSERS

C4	1	mfd.	200v.
C5	4	"	400v.
C7	.05	"	400v.
C8	.004	"	200v.
C13	1	"	400v.

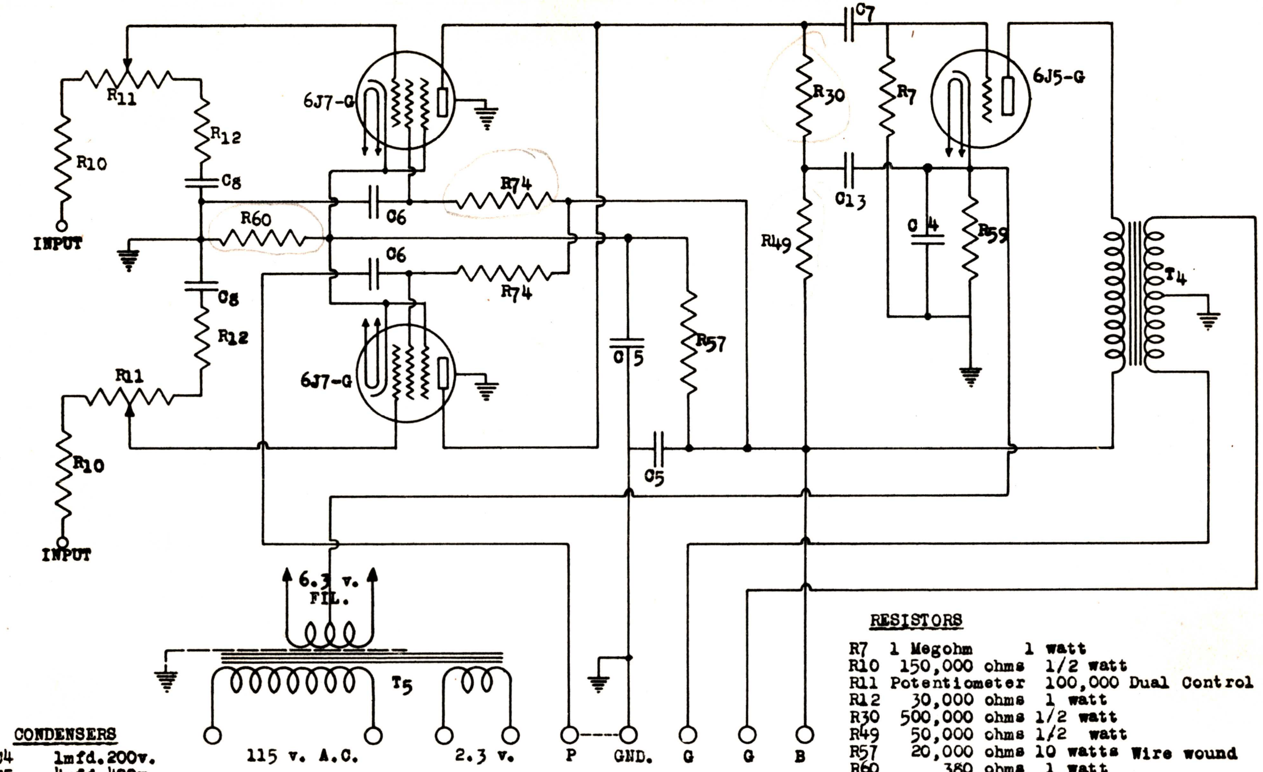
RESISTORS

R7	1 megohm		1	watt	
R10	150,000	ohms	½	"	
R11	100,000	"	Dual Tone Control		
R12	30,000	"	1	watt	
R18	5,000	"	½	"	
R19	7,500	"	"	"	
R36	25,000	"	"	"	
R56	265	"	1	"	
R57	20,000	"	10	"	Wire Wound
R58	350,000	"	1	"	
R59	2,700	"	1	"	

USED IN MODEL E CONSOLE
SERIAL NO.8472 & BELOW

- PRE-AMPLIFIER -
FIGURE 6

added ○


R11
R10
R12
C8
INPUT
R60
C8
R12
R11
R10
INPUT
6J7-G
C6
R74
C6
R74
6J7-G
C5
R57
C5
6.3 v.
FIL.
T5
115 v. A.C.
2.3 v.
P
GND.
G
G
B
C7
R30
R7
6J5-G
C13
R49
C4
R59
T4

CONDENSERS

C4	1mfd.200v.
C5	4mfd.400v.
C7	.05 mfd.400v.
C8	.004mfd.200v.
C13	1 mfd.400v.
C6	.1 mfd.400v.

RESISTORS

R7	1 Megohm	1 watt
R10	150,000 ohms	1/2 watt
R11	Potentiometer	100,000 Dual Control
R12	30,000 ohms	1 watt
R30	500,000 ohms	1/2 watt
R49	50,000 ohms	1/2 watt
R57	20,000 ohms	10 watts Wire wound
R60	380 ohms	1 watt
R59	2,700 ohms	1 watt
R74	5 Megohms	1 watt

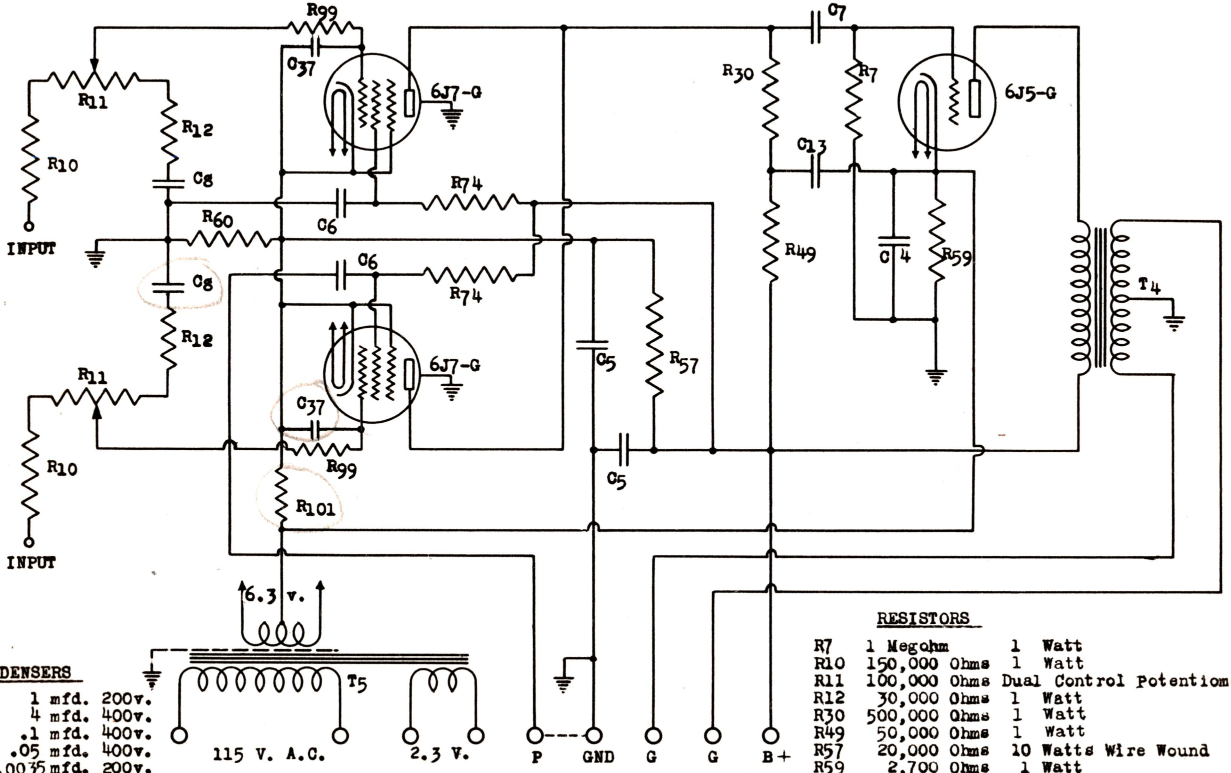
T4 Output Transformer
T5 Filament Transformer

PRE-AMPLIFIER

FIGURE 7

USED IN MODEL E CONSOLE
SERIAL NUMBER 8473 TO 8561 INCL.

added O


R99
C37
6J7-G
R11
R12
R10
INPUT
C8
R60
C6
R74
C6
C8
R74
R12
R11
6J7-G
C37
R10
R99
R101
INPUT
C5
R57
C5
R30
C7
R7
C13
R49
C4
R59
6J5-G
T4
6.3 v.
T5
115 V. A.C.
2.3 V.
P
GND
G
G
B+

CONDENSERS

C4	1 mfd.	200v.
C5	4 mfd.	400v.
C6	.1 mfd.	400v.
C7	.05 mfd.	400v.
C8	.0035 mfd.	200v.
C13	1 mfd.	400v.
C37	.0001 Mfd.	450v.

T4 Output Transformer
T5 Filament Transformer

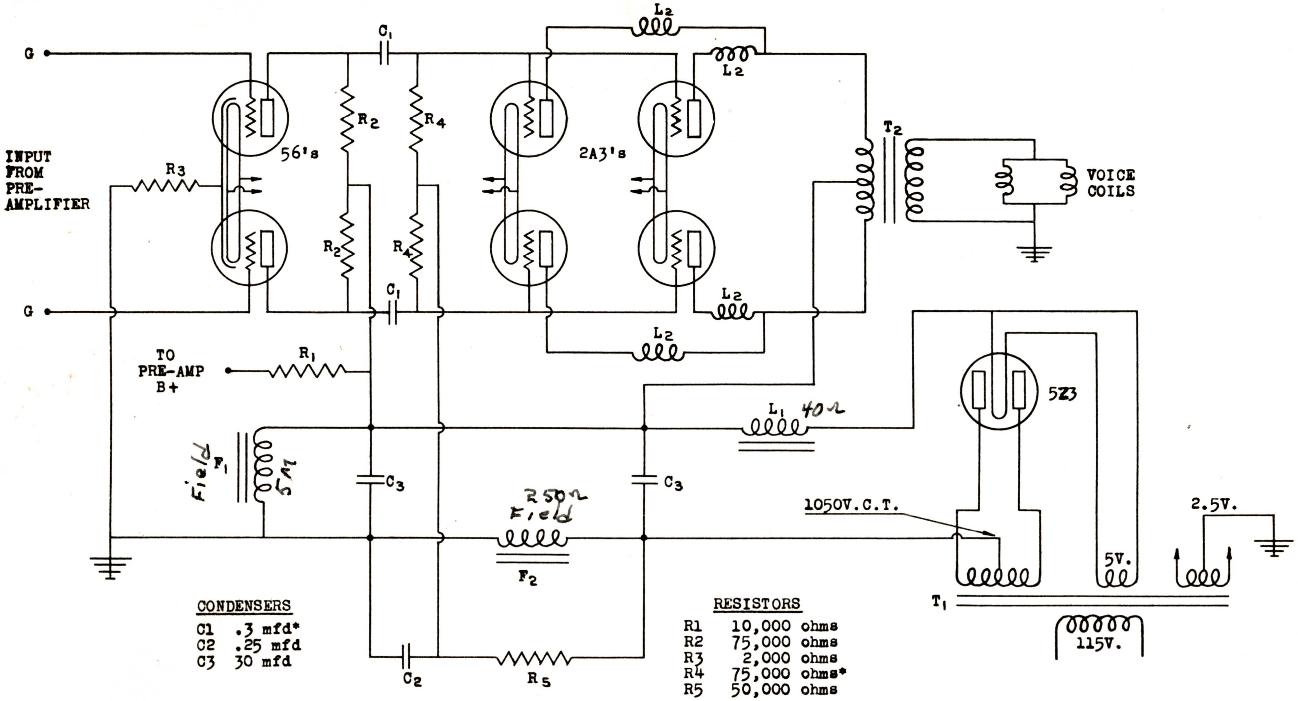
RESISTORS

R7	1 Megohm	1 Watt
R10	150,000 Ohms	1 Watt
R11	100,000 Ohms	Dual Control Potentiometer
R12	30,000 Ohms	1 Watt
R30	500,000 Ohms	1 Watt
R49	50,000 Ohms	1 Watt
R57	20,000 Ohms	10 Watts Wire Wound
R59	2,700 Ohms	1 Watt
R60	380 Ohms	1 Watt
R74	5 Megohms	1 Watt
R99	50,000 Ohms	.3 or .5 Watt
R1o1	400,000 Ohms	1 Watt

-PRE-AMPLIFIER-

FIGURE 8.

USED IN MODEL E CONSOLE
SERIAL NUMBER 8562 AND ABOVE
(C37 & R99 omitted in early)
(pre-amplifiers of this series.)


G
G
INPUT FROM PRE-AMPLIFIER
R3
56's
R2
R4
C1
R2
R4
C1
2A3's
L2
L2
L2
L2
T2
VOICE COILS
TO PRE-AMP B+
R1
5Z3
L1 40Ω
Field F1 5M
C3
C3
250Ω Field
F2
1050V.C.T.
2.5V.
5V.
T1
115V.
C2
R5

CONDENSERS

C1	.3 mfd*
C2	.25 mfd
C3	30 mfd

RESISTORS

R1	10,000 ohms
R2	75,000 ohms
R3	2,000 ohms
R4	75,000 ohms*
R5	50,000 ohms

F1	Speaker field,	5,000 ohms
F2	Speaker field,	250 ohms
L1	Filter choke	40 ohms
L2	Radio frequency choke	
T1	Power transformer	
T2	Output transformer (Primary 120 ohms) (Secondary 1/10 ohm)	

* A-20 cabinets below serial no.601, A-40 & B-40 cabinets below no.1731 have condenser C1 .1 mfd and resistor R4 200,000 ohms.

USED IN POWER CABINETS
A-20 SERIAL NO.999 AND BELOW
A-40,B-40 & C-40 NO.2399 AND BELOW

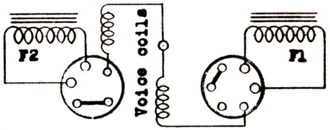
-POWER AMPLIFIER-

FIGURE 9

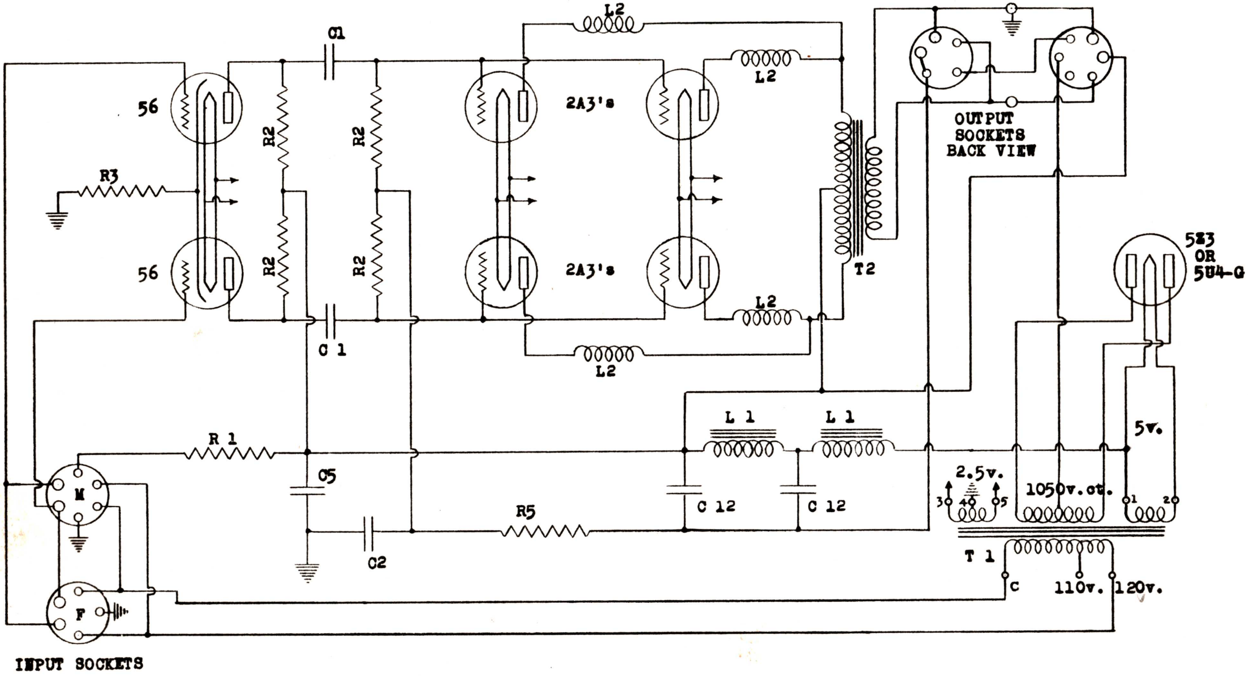
F1	Speaker field, 5,000 ohms
F2	Speaker field 250 ohms
L1	Filter choke 40 ohms
L2	R. F. choke
T1	Power transformer
T2	Output transformer (Prim. 120 ohms) D.C. resistance (Sec. .1 ohm)

CONDENSERS	
C1	.3 mfd
C2	.25 mfd
C5	4 mfd
C12	6 mfd

RESISTORS	
R1	10,000 ohms
R2	75,000 ohms
R3	2,000 ohms
R5	50,000 ohms


F2
Voice coils
F1

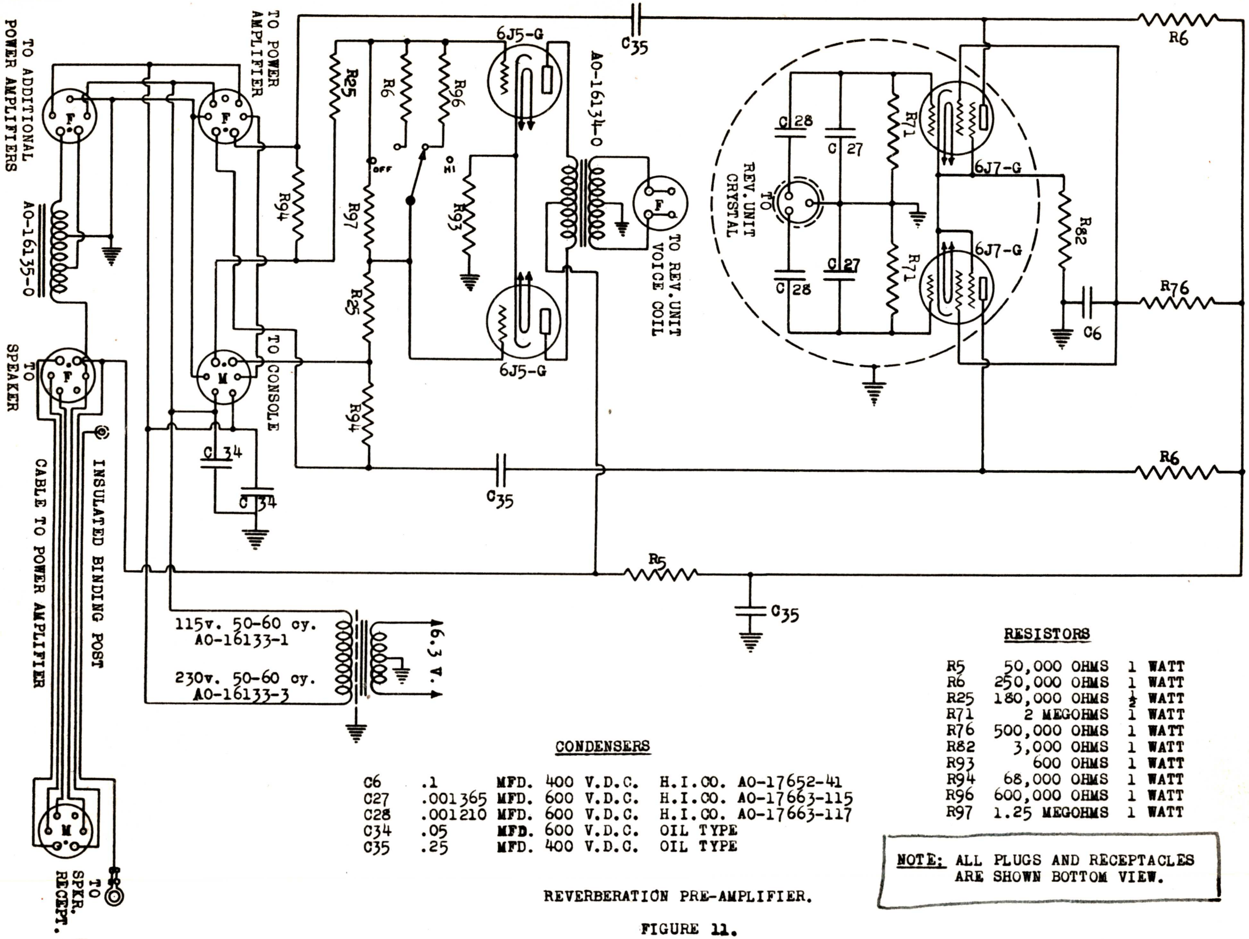
CONNECTIONS TO PLUGS.
FRONT VIEW


C1
L2
56
56
R3
R2
R2
R2
R2
C 1
2A3's
2A3's
L2
L2
L2
T2
OUTPUT SOCKETS BACK VIEW
5Z3 OR 5U4-G
R 1
C5
C2
R5
L 1
L 1
C 12
C 12
5v.
2.5v.
3
4
5
1050v.ct.
1
2
T 1
C
110v.
120v.
M
F
INPUT SOCKETS

USED IN POWER CABINETS
A-20 SERIAL NO.1000 AND ABOVE.
A-40, B-40 & C-40 NO.2400 & ABOVE.
ALSO ALL OTHER TYPE CABINETS.

-POWER AMPLIFIER-

FIGURE 10


TO ADDITIONAL POWER AMPLIFIERS
TO POWER AMPLIFIER
F
F
M
AO-16135-0
TO SPEAKER
TO CONSOLE
C 34
C 34
INSULATED BINDING POST
CABLE TO POWER AMPLIFIER
TO SPKR. RECEPT.
R25
R6
R96
R94
R97
OFF
HI
R93
R25
R94
6J5-G
6J5-G
C35
C35
AO-16134-0
TO REV. UNIT VOICE COIL
C 28
C 27
R71
TO REV. UNIT CRYSTAL
C 28
C 27
R71
6J7-G
6J7-G
R82
R76
C6
R6
R6
R5
C35
115v. 50-60 cy. AO-16133-1
230v. 50-60 cy. AO-16133-3
6.3 V.

CONDENSERS

C6	.1	MFD.	400 V.D.C.	H.I.CO.	AO-17652-41
C27	.001365	MFD.	600 V.D.C.	H.I.CO.	AO-17663-115
C28	.001210	MFD.	600 V.D.C.	H.I.CO.	AO-17663-117
C34	.05	MFD.	600 V.D.C.	OIL TYPE	
C35	.25	MFD.	400 V.D.C.	OIL TYPE	

RESISTORS

R5	50,000 OHMS	1 WATT
R6	250,000 OHMS	1 WATT
R25	180,000 OHMS	½ WATT
R71	2 MEGOHMS	1 WATT
R76	500,000 OHMS	1 WATT
R82	3,000 OHMS	1 WATT
R93	600 OHMS	1 WATT
R94	68,000 OHMS	1 WATT
R96	600,000 OHMS	1 WATT
R97	1.25 MEGOHMS	1 WATT

NOTE: ALL PLUGS AND RECEPTACLES ARE SHOWN BOTTOM VIEW.

REVERBERATION PRE-AMPLIFIER.

FIGURE 11.

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 1

OPERATING & CONSTRUCTIONAL DETAILS

B - The Model B Organ

Hammond Instrument Company
2915 North Western Avenue
Chicago, Illinois

10/15/42 (Revised)
Printed in U.S.A

OPERATION

The console is identical in appearance with Model A except that the depth from front to back is increased approximately 5" to accommodate an added unit known as the chorus generator. One extra black drawbar has been added which operates a switch to turn the chorus generator on or off at will. This drawbar, labelled Chorus, is located at the extreme right hand end of the console.

When this model is played with the Chorus drawbar pushed in (the "off" position) it operates in exactly the same way as the Model A console. Pulling the drawbar out (to the "on" position) instantaneously adds the ensemble or chorus effect to whatever is being played. Actually it adds a series of slightly sharp and slightly flat tones to the true tones produced by the main generator.

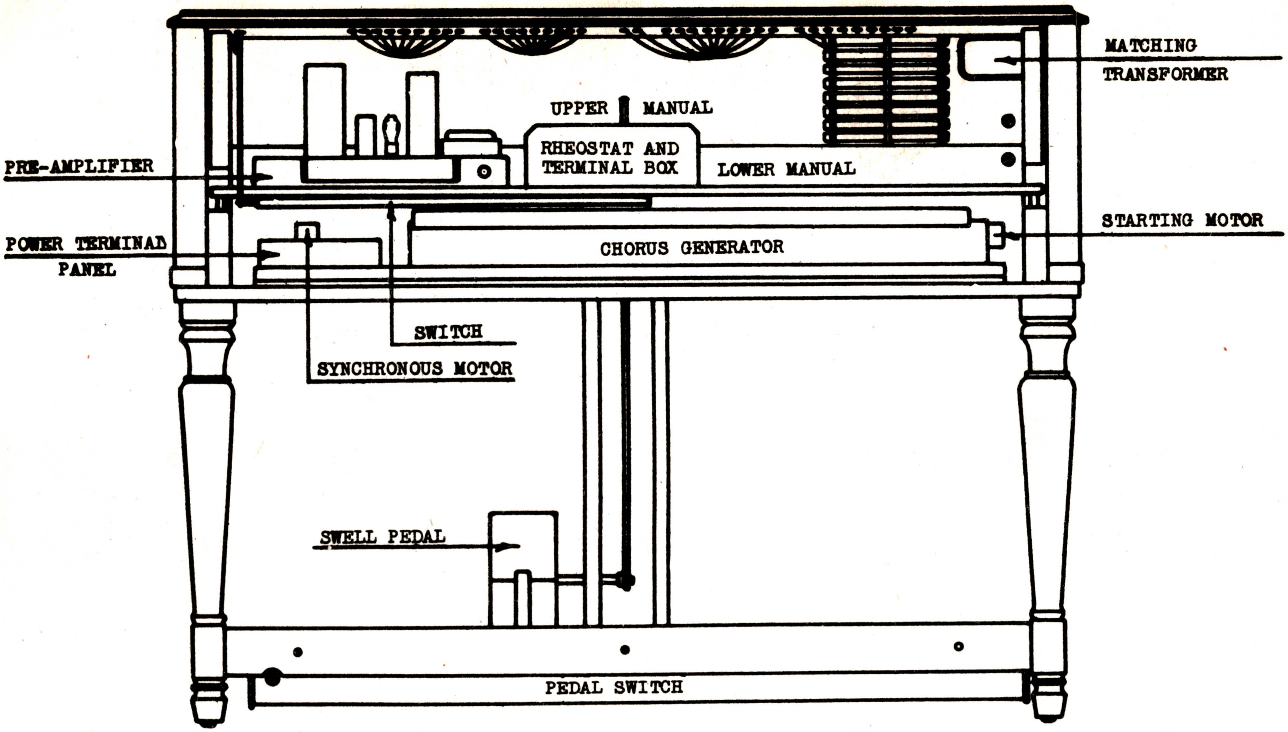
The true frequencies are generated, as in the Model A console, by a regular generator assembly. The slightly sharp and slightly flat frequencies are generated by the special "chorus generator" which is a feature of this model. The resulting electrical wave contains a complex series of undulations which enhance the pleasing effect of many tone qualities, notably string and full organ combinations.

CONSTRUCTION

Figure 1 shows the rear view of the console. The chorus generator may be seen beside the main generator. It will be noted that the rheostat box and pre-amplifier have been mounted on a channel to make room for the chorus generator below. There have been no other noticeable changes in placement of parts.

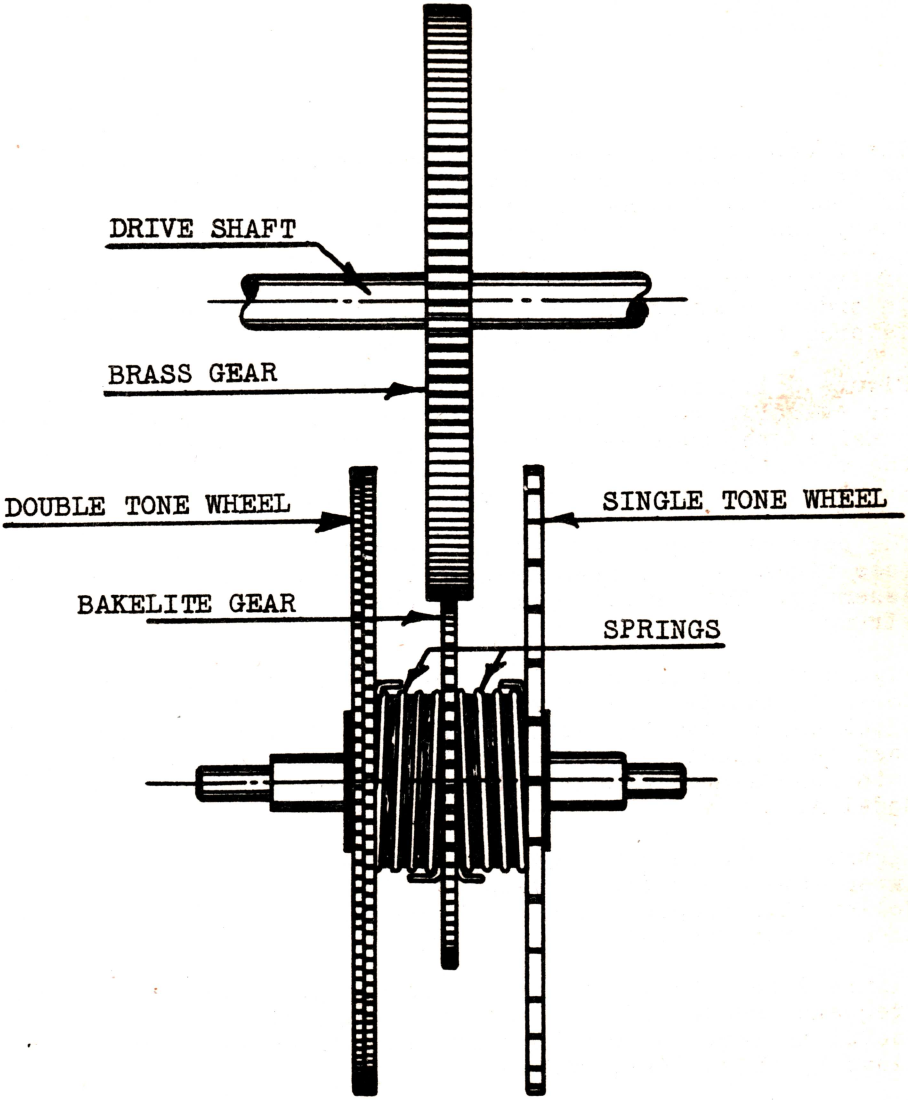
The chorus generator assembly, like the main generator, has a drive shaft with 24 brass gears. Each gear drives a single assembly consisting of two tone wheels. The drive gears vary as to number of teeth, and the tone wheels therefore operate at 24 different speeds.

The chorus generator has 48 tone wheels, each with a separate magnet and pick up coil. Of these generators, 24 are single and 24 are double. The double tone wheels, (see Figure 2) consist of two discs with different numbers of teeth mounted on one brass hub. The single wheels are electrically connected in pairs; each pair so connected has the same effect as one double wheel.


MATCHING TRANSFORMER
UPPER MANUAL
RHEOSTAT AND TERMINAL BOX
LOWER MANUAL
PRE-AMPLIFIER
STARTING MOTOR
POWER TERMINAD PANEL
CHORUS GENERATOR
SWITCH
SYNCHRONOUS MOTOR
SWELL PEDAL
PEDAL SWITCH

REAR VIEW OF CONSOLE WITH BACK REMOVED

FIGURE 1


DRIVE SHAFT
BRASS GEAR
DOUBLE TONE WHEEL
SINGLE TONE WHEEL
BAKELITE GEAR
SPRINGS

TONE WHEEL ASSEMBLY

FIGURE 2

The frequencies covered by the chorus generator are numbers 56 to 91 inclusive on the main generator. The difference in frequency between the main generator and either flat or sharp tone is .8% for frequencies 56 to 67 and .4% for frequencies 68 to 91. It is necessary that a lesser percentage of frequency difference be present in the higher register in order to avoid too rapid undulation. No chorus effect is produced on frequencies below 56.

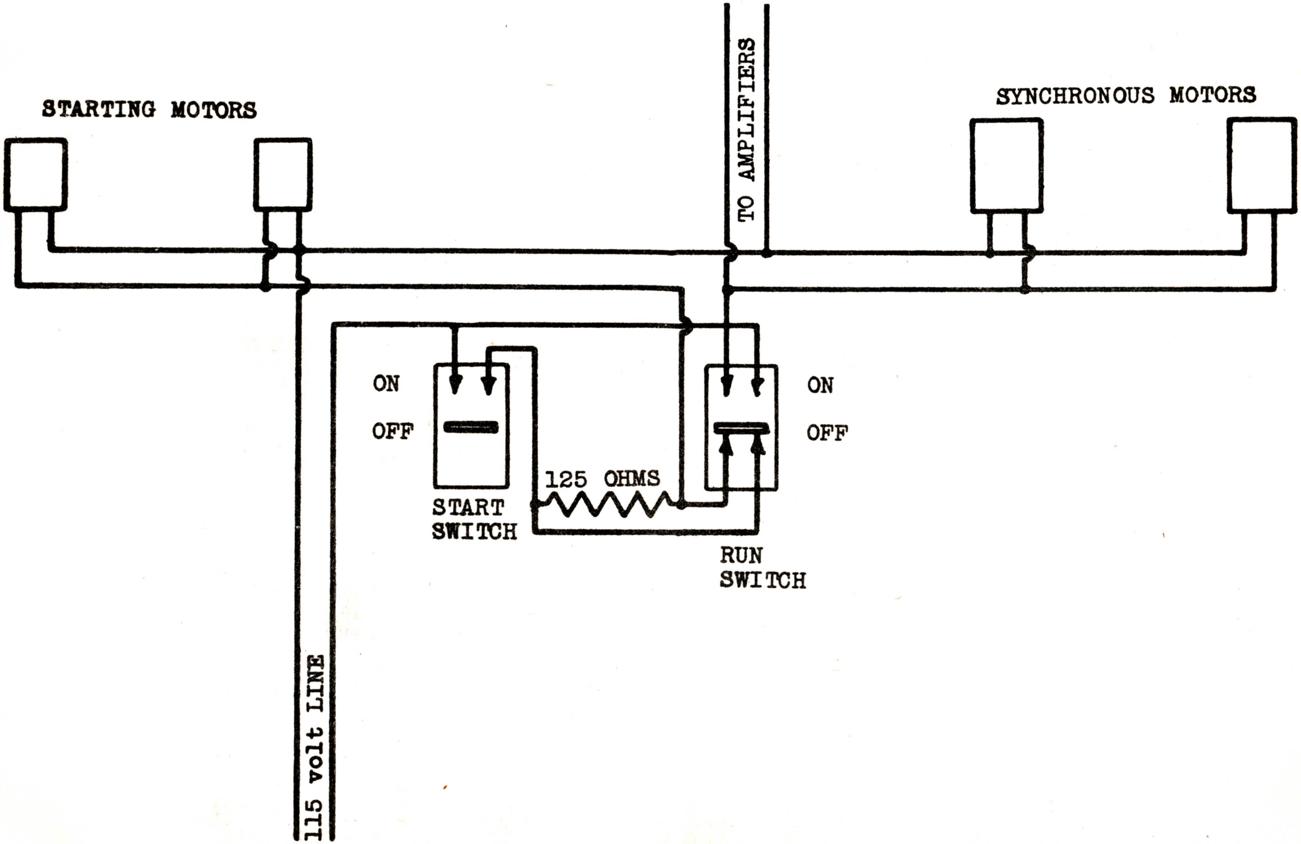
Figure 3 illustrates the revised switch and motor circuit for starting two generators in parallel. The power terminal panel is the same as that used in the Model A console with the exception that a 125 ohm resistor is used, since both starting motors are connected in parallel.

The physical appearance of the rheostat and terminal box (see figure 4) has been changed somewhat from the Model A assembly. This rearrangement, however, does not affect the wiring.

Figure 5 shows the signal wiring circuit for the two generators. A multi-contact switch operated mechanically by the black chorus drawbar at the right side of the console is used to connect electrically the chorus generator to the main generator. Manual and pedal circuits are same as Model A.

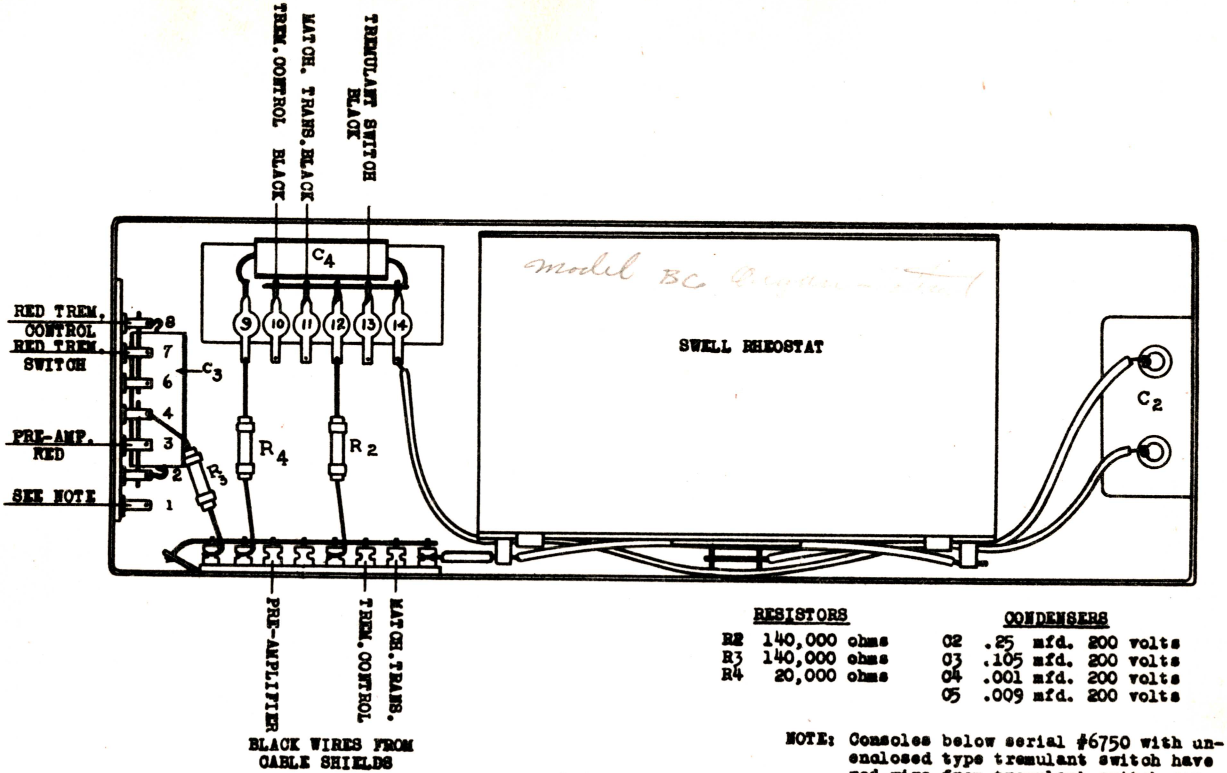
Figure 6 is a complete wiring diagram for connections between main and chorus generator. The service man should follow this diagram closely in making a service replacement of a chorus generator.

Figure 7 is a back view of the chorus generator indicating frequency number of each magnet. This, too, will be found useful in service when it becomes necessary to locate and clear up silent frequencies.


STARTING MOTORS
TO AMPLIFIERS
SYNCHRONOUS MOTORS
ON
OFF
START SWITCH
125 OHMS
ON
OFF
RUN SWITCH
115 volt LINE

SWITCH AND MOTOR CIRCUITS

FIGURE 3

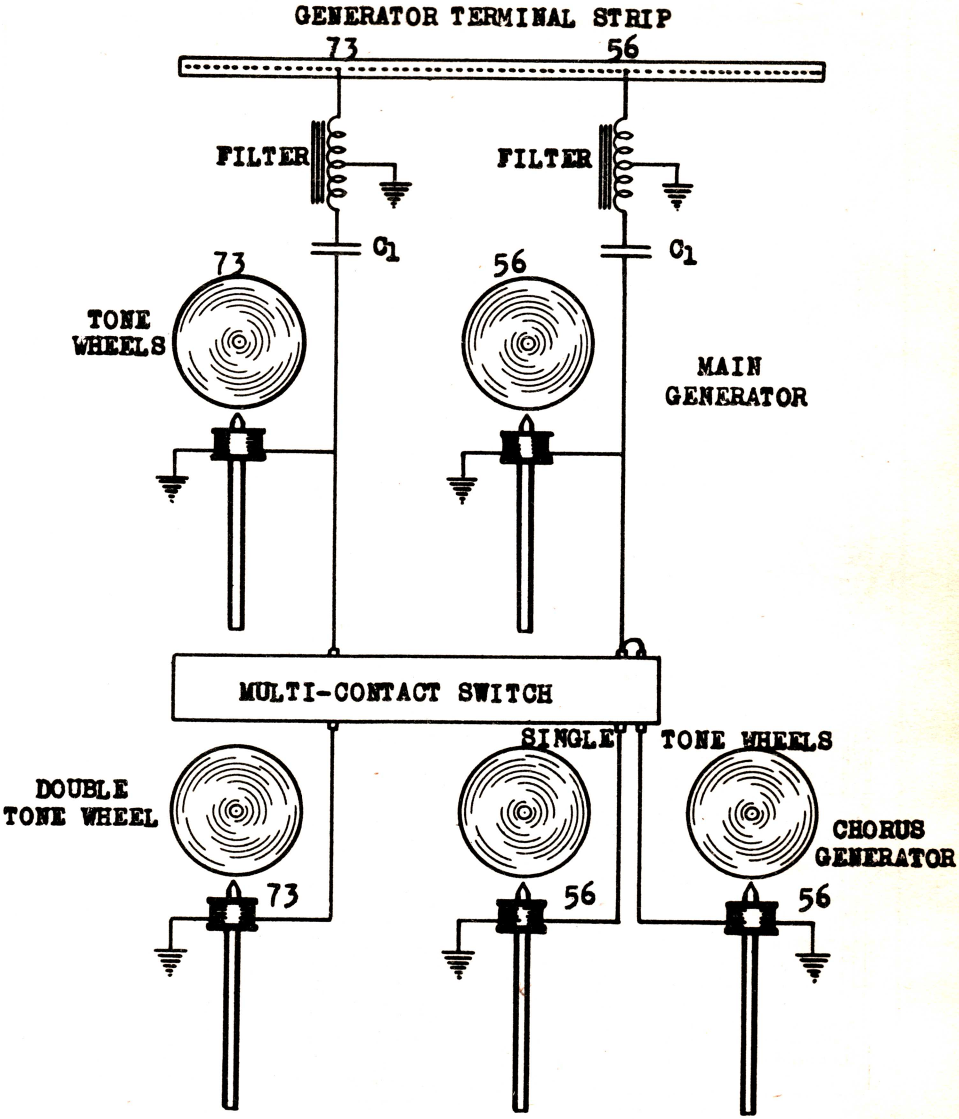

TREMULANT SWITCH BLACK
MATCH. TRANS. BLACK
TREM. CONTROL BLACK
C4
9
10
11
12
13
14
Model BC Organ – [illegible]
SWELL RHEOSTAT
C2
RED TREM. CONTROL
RED TREM. SWITCH
PRE-AMP. RED
SEE NOTE
8
7
6
4
3
2
1
C3
R3
R4
R2
PRE-AMPLIFIER
TREM. CONTROL
MATCH. TRANS.
BLACK WIRES FROM CABLE SHIELDS

RESISTORS	
R2	140,000 ohms
R3	140,000 ohms
R4	20,000 ohms

CONDENSERS		
C2	.25 mfd.	200 volts
C3	.105 mfd.	200 volts
C4	.001 mfd.	200 volts
C5	.009 mfd.	200 volts

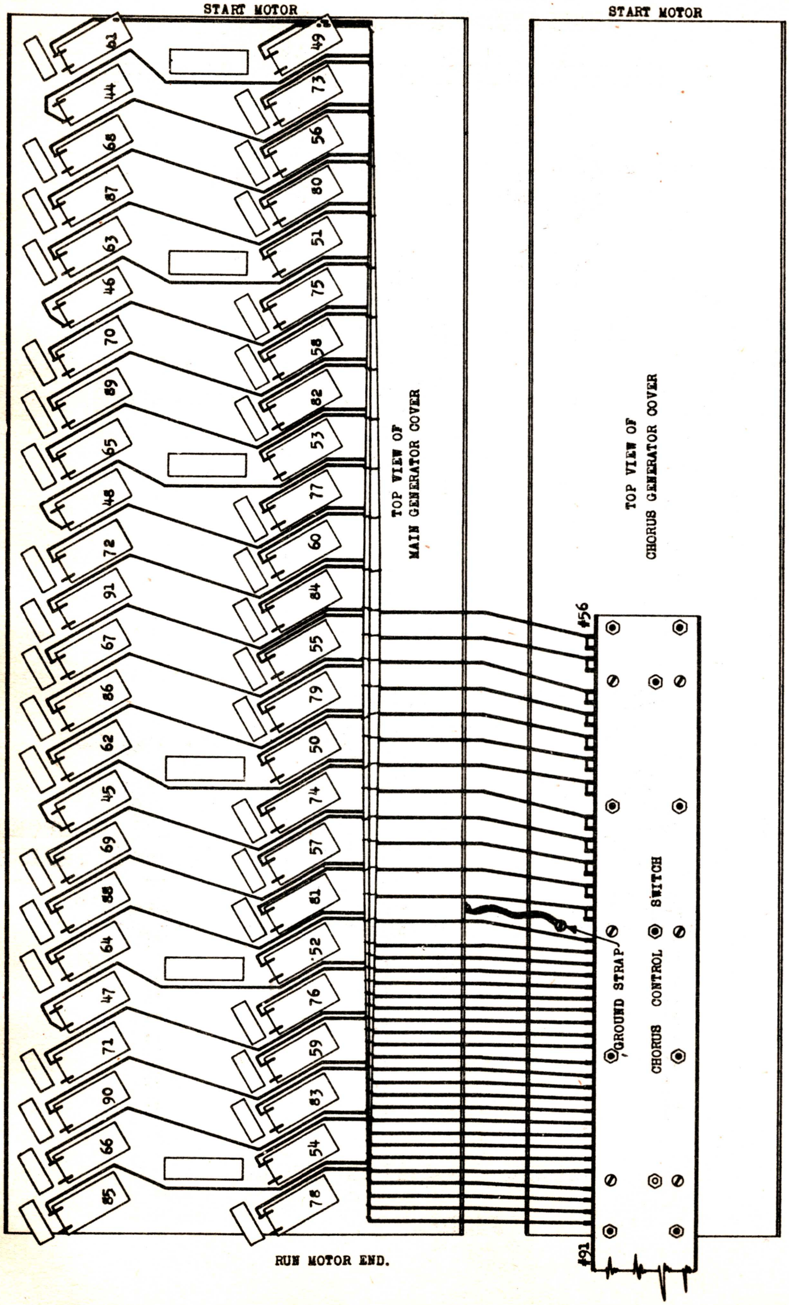
RHEOSTAT BOX CONNECTIONS
FIGURE 4.

NOTE: Consoles below serial #6750 with unenclosed type tremulant switch have red wire from tremulant switch connected to terminal #1, and condenser C5 between terminals #1 and #7


GENERATOR TERMINAL STRIP
73
56
FILTER
FILTER
C_1
C_1
73
56
TONE WHEELS
MAIN GENERATOR
MULTI-CONTACT SWITCH
SINGLE
TONE WHEELS
DOUBLE TONE WHEEL
CHORUS GENERATOR
73
56
56

CHORUS GENERATOR WIRING

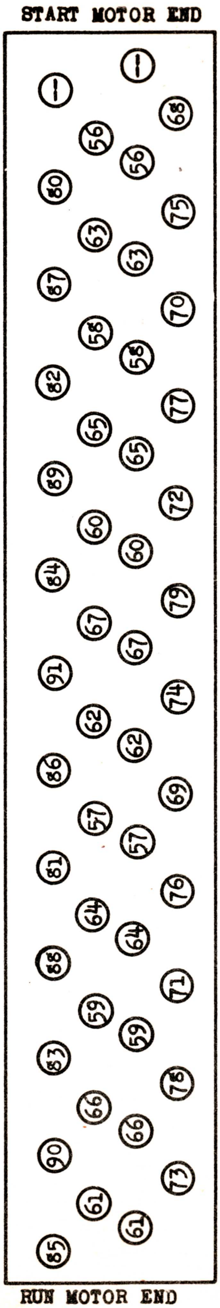
FIGURE 5.


START MOTOR
START MOTOR
TOP VIEW OF MAIN GENERATOR COVER
TOP VIEW OF CHORUS GENERATOR COVER
RUN MOTOR END.
#56
#91
GROUND STRAP
CHORUS CONTROL SWITCH
61
44
68
87
63
46
70
89
65
48
72
91
67
86
62
45
69
88
64
47
71
90
66
85
49
73
56
80
51
75
58
82
53
77
60
84
55
79
50
74
57
81
52
76
59
83
54
78

NOTE; NUMBERS SHOWN ON FILTER TRANSFORMERS ARE FREQUENCY NUMBERS.

CABLE CONNECTIONS TO CHORUS GENERATOR

FIGURE 6.


START MOTOR END
1
80
87
82
89
84
91
86
81
88
83
90
85
56
63
58
65
60
67
62
57
64
59
66
61
1
56
63
58
65
60
67
62
57
64
59
66
61
68
75
70
77
72
79
74
69
76
71
78
73
RUN MOTOR END

BACK VIEW OF CHORUS GENERATOR

CHORUS GENERATOR MAGNET LOCATIONS

FIGURE 7.

(NUMBERS SHOWN ARE FREQUENCY NUMBERS)

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART I

Operating and Constructional Details

C. The Model E Organ

Hammond Instrument Company,
2915 N. Western Avenue,
Chicago, Illinois

6/1/44

OPERATION

Model E (see page 7 of the introductory section) is the largest of Hammond consoles. It is identical with Model B in tonal resources, but is larger in size and several features have been incorporated to assist the organist in providing more flexible control. Model E is the ideal instrument for the professional concert organist.

The salient features of the Model E include a standard AGO 32 note concave and radiating pedal clavier. separate expression pedals - one for the Swell manual and one for the Great and Pedals, separate tremulants pedal toe pistons, Great to Pedal 8' coupler, and labeled preset pistons.

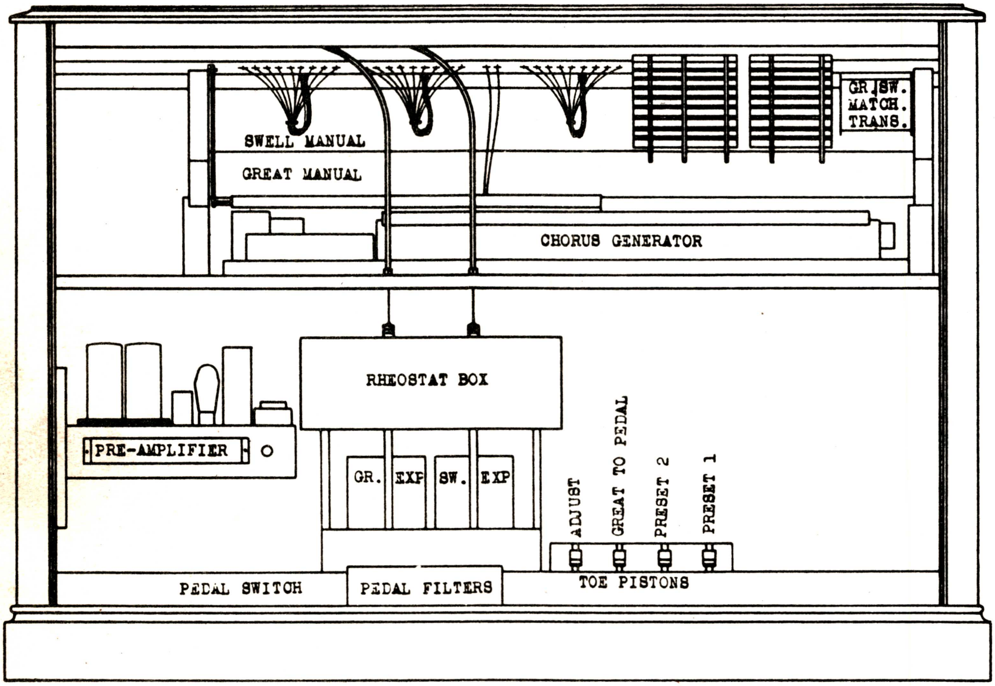
To the service man this console should be considered merely an elaboration of the Model B. Familiarity with other Hammond consoles should enable a service man to properly install, maintain and repair the Model E. The material contained in Sections 1 and 1B of this manual, together with the following description of new features, covers all details of interest to the service man. Figure 1, the rear view of the console, shows the position of each major assembly in the Model E.

CONSTRUCTION

Manual Chassis Assembly

The appearance of the upper or Swell manual and the lower or Great manual is the same as the Model B except that numbered pistons are used instead of preset keys, and there are two tremulant controls and two expression pedal indicators. One tremulant control operates for each manual, and the expression pedal indicators show at a glance the position of the pedals. Labels are provided so that the combination set up on each preset button may be identified. These labels are easily changed when any new combination is set up The harmonic control drawbars, start and run switches, and chorus control are in their normal positions. (See Figures 2 and 3.)

In playing equipment the manual chassis is similar to Model B, but the two are not interchangeable. The keys, controls, switches and many other parts are common to both consoles however, so the ser-


SWELL MANUAL
GREAT MANUAL
GR.SW. MATCH. TRANS.
CHORUS GENERATOR
RHEOSTAT BOX
PRE-AMPLIFIER
GR. EXP
SW. EXP
ADJUST
GREAT TO PEDAL
PRESET 2
PRESET 1
PEDAL SWITCH
PEDAL FILTERS
TOE PISTONS

MODEL E CONSOLE
REAR VIEW WITH BACK REMOVED
FIGURE 1.

vice man will find it possible to use standard Hammond parts for either instrument.

Both manuals are wired internally exactly as in other models. Figure 4 shows the frequency numbers used for each playing key. This chart should prove helpful to the service man in tracing a dead or weak note to the proper section of the generator assembly. Figure 6 shows connections through the manuals, drawbars and preset panel to the matching transformers. The use of two tremulants and two expression pedals requires that the drawbar assembly and the preset panel be divided, with one part connected to each matching transformer. Pedal drawbars and presets connect to the great manual circuit.

Tone Generator Assembly

The tone generators are constructed and wired exactly like previous models (see Figure 5, part 1B) with the exception that two tremulant switches are used, one mounted on each synchronous motor. The tremulants operate at two different speeds, the one on the main generator at 400 r.p.m. for the Great manual, and the other at 348 r.p.m. for the Swell manual. The chorus drawbar makes it possible to introduce the chorus effect at will.

Among the major assemblies, the main generator is the only one which is interchangeable between Model B and E consoles. The chorus generator may also be changed from one type of console to the other, but a run motor with tremulant is used in the E while a run motor without tremulant is used in the B.

Pedal Switch Assembly

Nine bus bars are used in the Model E Pedal switch assembly. Figure 7 illustrates the arrangement of these bus bars and the nine contact springs of a typical pedal key. The frequencies used in the pedal switch are listed in Figure 5. Each pedal piston has a similar assembly of contacts, with a locking arrangement by which only one piston remains in operation at one time.

Frequencies impressed on the bus bars when a pedal is played are picked up by the contacts of the pedal piston which is in use and go from there to the preset panel through pistons 1 or 2 or to the drawbars through piston 4. From the coupler (piston 3) the upper seven harmonics connect to bus bars in the Great manual, while the lower two connect to the lower pedal drawbar and permit it to be used with the coupler. Connections from the pedals to the manual wiring circuit are indicated in Figure 6. A low voltage line

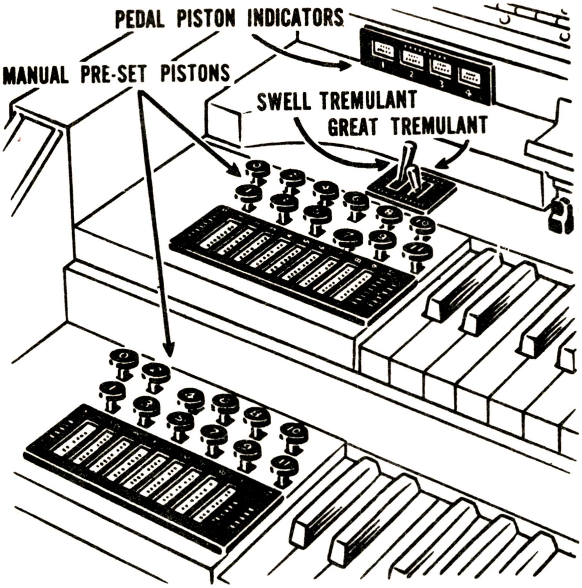

PEDAL PISTON INDICATORS
MANUAL PRE-SET PISTONS
SWELL TREMULANT
GREAT TREMULANT

FIGURE 2.

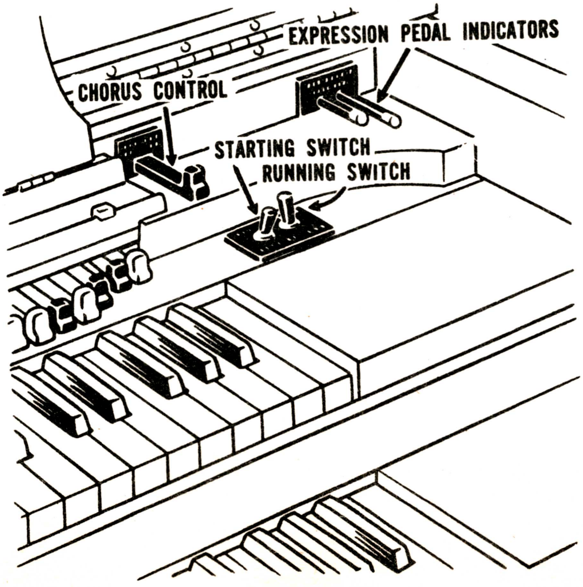

EXPRESSION PEDAL INDICATORS
CHORUS CONTROL
STARTING SWITCH
RUNNING SWITCH

FIGURE 3.

Key Number	Note	Drawbar 1 Sub-Fund.	Drawbar 2 Sub-3rd	Drawbar 3 Fund.	Drawbar 4 2nd Harm.	Drawbar 5 3rd Harm.	Drawbar 6 4th Harm.	Drawbar 7 5th Harm.	Drawbar 8 6th Harm.	Drawbar 9 8th Harm.
1	C	1	20	13	25	32	37	41	44	49
2	C#	2	21	14	26	33	38	42	45	50
3	D	3	22	15	27	34	39	43	46	51
4	D#	4	23	16	28	35	40	44	47	52
5	E	5	24	17	29	36	41	45	48	53
6	F	6	25	18	30	37	42	46	49	54
7	F#	7	26	19	31	38	43	47	50	55
8	G	8	27	20	32	39	44	48	51	56
9	G#	9	28	21	33	40	45	49	52	57
10	A	10	29	22	34	41	46	50	53	58
11	A#	11	30	23	35	42	47	51	54	59
12	B	12	31	24	36	43	48	52	55	60
13	C	13	32	25	37	44	49	53	56	61
14	C#	14	33	26	38	45	50	54	57	62
15	D	15	34	27	39	46	51	55	58	63
16	D#	16	35	28	40	47	52	56	59	64
17	E	17	36	29	41	48	53	57	60	65
18	F	18	37	30	42	49	54	58	61	66
19	F#	19	38	31	43	50	55	59	62	67
20	G	20	39	32	44	51	56	60	63	68
21	G#	21	40	33	45	52	57	61	64	69
22	A	22	41	34	46	53	58	62	65	70
23	A#	23	42	35	47	54	59	63	66	71
24	B	24	43	36	48	55	60	64	67	72
25	C	25	44	37	49	56	61	65	68	73
26	C#	26	45	38	50	57	62	66	69	74
27	D	27	46	39	51	58	63	67	70	75
28	D#	28	47	40	52	59	64	68	71	76
29	E	29	48	41	53	60	65	69	72	77
30	F	30	49	42	54	61	66	70	73	78
31	F#	31	50	43	55	62	67	71	74	79
32	G	32	51	44	56	63	68	72	75	80
33	G#	33	52	45	57	64	69	73	76	81
34	A	34	53	46	58	65	70	74	77	82
35	A#	35	54	47	59	66	71	75	78	83
36	B	36	55	48	60	67	72	76	79	84
		Frequency Number								

(continued on next page)

FIGURE 4.

(continued from preceding page)

Key Number	Note	Drawbar 1 Sub-Fund.	Drawbar 2 Sub-3rd	Drawbar 3 Fund.	Drawbar 4 2nd Harm.	Drawbar 5 3rd Harm.	Drawbar 6 4th Harm.	Drawbar 7 5th Harm.	Drawbar 8 6th Harm.	Drawbar 9 8th Harm.
37	C	37	56	49	61	68	73	77	80	85
38	C#	38	57	50	62	69	74	78	81	86
39	D	39	58	51	63	70	75	79	82	87
40	D#	40	59	52	64	71	76	80	83	88
41	E	41	60	53	65	72	77	81	84	89
42	F	42	61	54	66	73	78	82	85	90
43	F#	43	62	55	67	74	79	83	86	91
44	G	44	63	56	68	75	80	84	87	68
45	G#	45	64	57	69	76	81	85	88	69
46	A	46	65	58	70	77	82	86	89	70
47	A#	47	66	59	71	78	83	87	90	71
48	B	48	67	60	72	79	84	88	91	72
49	C	49	68	61	73	80	85	89	80	73
50	C#	50	69	62	74	81	86	90	81	74
51	D	51	70	63	75	82	87	91	82	75
52	D#	52	71	64	76	83	88	80	83	76
53	E	53	72	65	77	84	89	81	84	77
54	F	54	73	66	78	85	90	82	85	78
55	F#	55	74	67	79	86	91	83	86	79
56	G	56	75	68	80	87	80	84	87	80
57	G#	57	76	69	81	88	81	85	88	81
58	A	58	77	70	82	89	82	86	89	82
59	A#	59	78	71	83	90	83	87	90	83
60	B	60	79	72	84	91	84	88	91	84
61	C	61	80	73	85	80	85	89	80	85
		Frequency Number								

Frequencies Used in Manuals

Models B and E

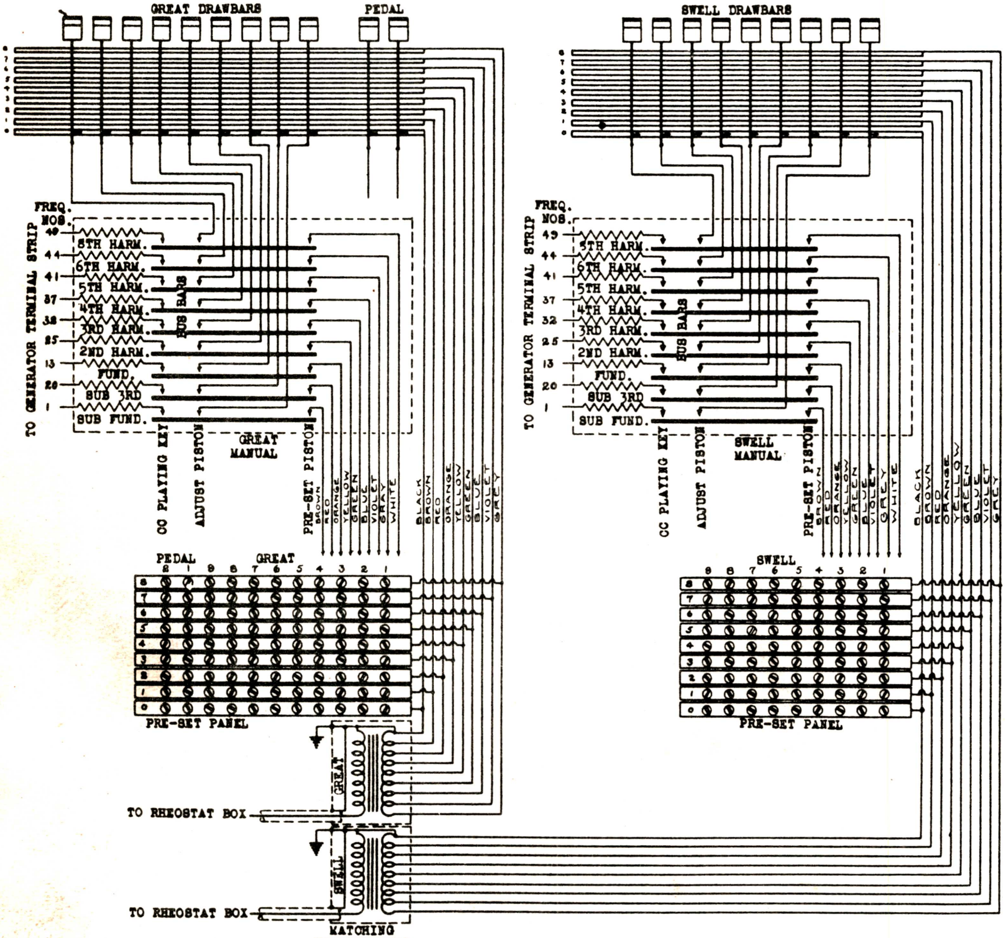
Figure 4

Pedal No.	Note	Fund.	3rd Harm.	2nd Harm.	4th Harm.	6th Harm.	8th Harm.	10th Harm.	12th Harm.	16th Harm.
1	C	1	20	13	25	32	37	41	44	49
2	C#	2	21	14	26	33	38	42	45	50
3	D	3	22	15	27	34	39	43	46	51
4	D#	4	23	16	28	35	40	44	47	52
5	E	5	24	17	29	36	41	45	48	53
6	F	6	25	18	30	37	42	46	49	54
7	F#	7	26	19	31	38	43	47	50	55
8	G	8	27	20	32	39	44	48	51	56
9	G#	9	28	21	33	40	45	49	52	57
10	A	10	29	22	34	41	46	50	53	58
11	A#	11	30	23	35	42	47	51	54	59
12	B	12	31	24	36	43	48	52	55	60
13	C	13	32	25	37	44	49	53	56	61
14	C#	14	33	26	38	45	50	54	57	62
15	D	15	34	27	39	46	51	55	58	63
16	D#	16	35	28	40	47	52	56	59	64
17	E	17	36	29	41	48	53	57	60	65
18	F	18	37	30	42	49	54	58	61	66
19	F#	19	38	31	43	50	55	59	62	67
20	G	20	39	32	44	51	56	60	63	68
21	G#	21	40	33	45	52	57	61	64	69
22	A	22	41	34	46	53	58	62	65	70
23	A#	23	42	35	47	54	59	63	66	71
24	B	24	43	36	48	55	60	64	67	72
25	C	25	44	37	49	56	61	65	68	73
26	C#	26	45	38	50	57	62	66	69	74
27	D	27	46	39	51	58	63	67	70	75
28	D#	28	47	40	52	59	64	68	71	76
29	E	29	48	41	53	60	65	69	72	77
30	F	30	49	42	54	61	66	70	73	78
31	F#	31	50	43	55	62	67	71	74	79
32	G	32	51	44	56	63	68	72	75	80
		Frequency Number								

Frequencies Used in Pedal Switch

Model E

FIGURE 5.


GREAT DRAWBARS
PEDAL
SWELL DRAWBARS
8
7
6
5
4
3
2
1
0
FREQ. NOS.
TO GENERATOR TERMINAL STRIP
49
44
41
37
32
25
13
20
1
8TH HARM.
6TH HARM.
5TH HARM.
4TH HARM.
3RD HARM.
2ND HARM.
FUND.
SUB 3RD
SUB FUND.
BUS BARS
CC PLAYING KEY
ADJUST PISTON
GREAT MANUAL
SWELL MANUAL
PRE-SET PISTON
BROWN
RED
ORANGE
YELLOW
GREEN
BLUE
VIOLET
GRAY
GREY
WHITE
BLACK
PEDAL
GREAT
SWELL
9
PRE-SET PANEL
GREAT
SWELL
TO RHEOSTAT BOX
MATCHING TRANSFORMERS

WIRING OF MANUAL CIRCUITS
MODEL E CONSOLE
FIGURE 6.

from the preamplifier filament transformer operates the 2.5 volt piston indicator lamps through the external contacts on the pedal switch. These lamps, as well as the transparent labels, may be changed when necessary by removing the plate over them. Several filter chokes and resistors mounted on the pedal switch are wired in series with leads from the lower pedal harmonics.

Matching Transformer Assemblies

The circuit separating the manuals is divided at the matching transformers. Two are used, one to accommodate the Swell manual, and the other for the Great and Pedals. These transformers are identical with those used in other model consoles, but are installed in smaller shielded housings. Both transformers are mounted on the end block at the right side of the manual chassis looking in from the rear (see Figure 1).

Rheostat and Terminal Box

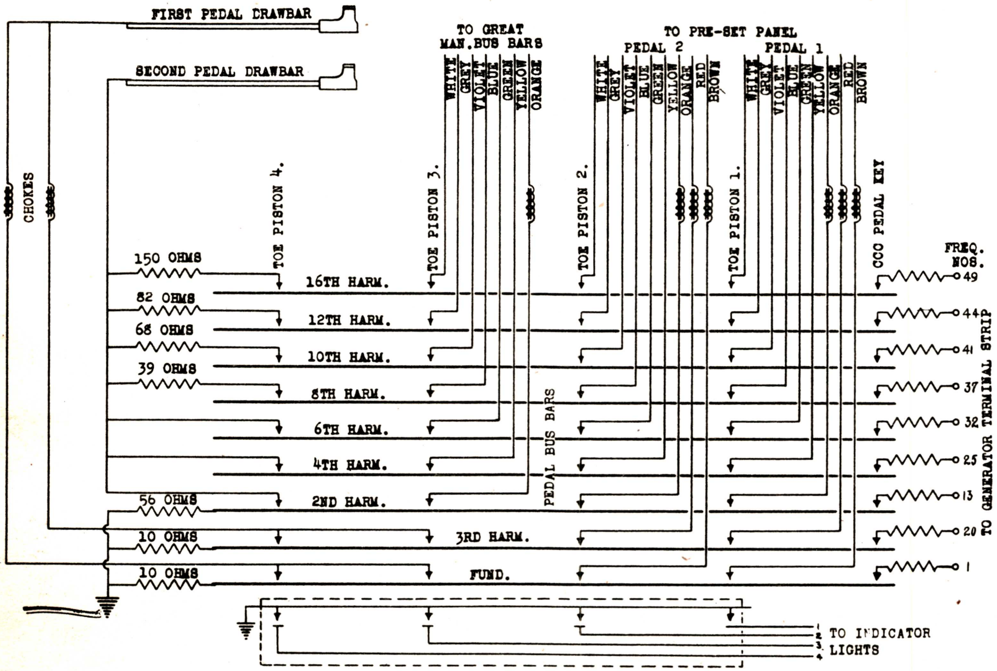
The rheostat and terminal box is likewise divided. Wiring detail is shown in Figure 8, and the arrangement of parts is shown in Figure 9. There are two independent circuits from the matching transformers through the rheostat box, each with a tremulant switch, a tremulant control, an expression pedal rheostat, and the usual resistors and condensers.

Pre-amplifier Assembly

Figure 10 shows the pre-amplifier circuit. It is similar to that used in Model B consoles, but has two input tubes for the two circuits from the rheostat box. Two 6J7G tubes and one 6C5G tube are used. It is equipped with a tone control like other Hammond pre-amplifiers, and connects to the console-to-cabinet cable at the output panel.

Expression or Swell Pedals

Two expression pedals are provided. Both are equipped with adjustable clamps to regulate the tension and distance through which they move. The expression pedal indicators, operated by wires from the rheostat box, are also adjustable.


FIRST PEDAL DRAWBAR
SECOND PEDAL DRAWBAR
TO GREAT MAN. BUS BARS
WHITE
GREY
VIOLET
BLUE
GREEN
YELLOW
ORANGE
TO PRE-SET PANEL
PEDAL 2
PEDAL 1
RED
BROWN
CHOKES
TOE PISTON 4.
TOE PISTON 3.
TOE PISTON 2.
TOE PISTON 1.
CCC PEDAL KEY
FREQ. NOS.
150 OHMS
82 OHMS
68 OHMS
39 OHMS
56 OHMS
10 OHMS
10 OHMS
16TH HARM.
12TH HARM.
10TH HARM.
8TH HARM.
6TH HARM.
4TH HARM.
2ND HARM.
3RD HARM.
FUND.
PEDAL BUS BARS
49
44
41
37
32
25
13
20
1
TO GENERATOR TERMINAL STRIP
1
2
3
4
TO INDICATOR LIGHTS

WIRING OF PEDAL CIRCUITS
MODEL E CONSOLE
FIGURE 7.

The pedal indicators are located at the extreme right side of the console above the swell manual. They consist of sliding rods with white indicator tips. One of the indicators is associated with each pedal and they move out into view as the pedals are advanced, serving to show the pedal positions at all times.

Pedal Toe Pistons

Four pedal toe pistons (see Figure 11) are located to the left of the expression pedals. Numbers one and two of these pistons are pedal presets. The third is a Great-to-Pedal coupler, and the fourth connects the pedals to the adjustable pedal drawbars. The left pedal drawbar may be used with the coupler to add 16' tone.

Lighted piston indicators are provided on the left side of the console just above the Swell manual. Each time a different toe piston is depressed, the proper indicator is automatically illuminated so the organist always knows which toe piston is depressed.

32 Note Pedal Clavier

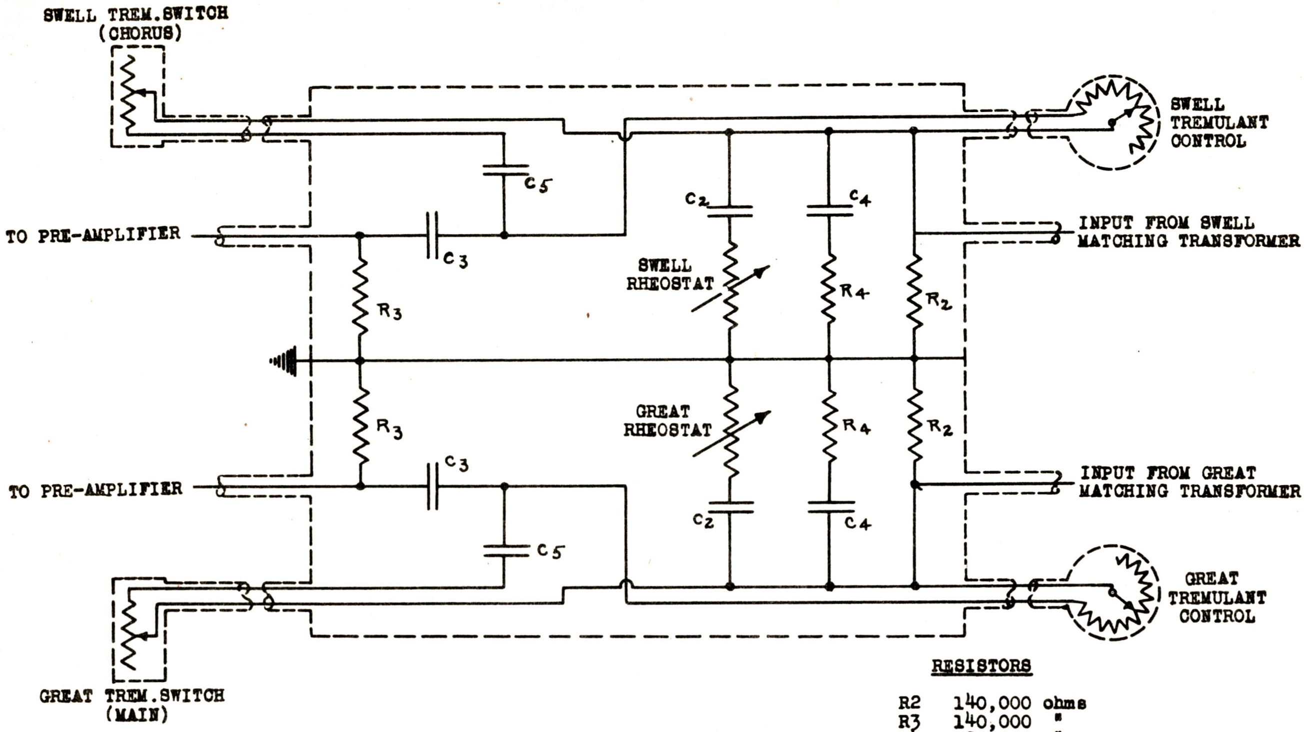
The pedal clavier is built to AGO specifications. It has 32 notes and is concave and radiating. In construction it is similar to the Model B pedal clavier. The wood pedal arms are made of maple, treated to resist wear. The black pedal caps are made of moulded plastic.

Installation of the pedals is accomplished by lifting them onto the short runners near the floor on the inside walls of the console, then pushing them forward until they lock in place. The piece of cloth attached to the middle of the pedal clavier should lie forward along the top of the metal springs to protect them from dirt which might drop from the expression pedals.

Cable Terminal Box

Cables are not permanently attached to the Model E console. A terminal box is provided at the lower left side of the console, looking in from the back. The cable from the preamplifier terminates at this point, and the power circuit is likewise connected here (See Figure 12.)

Power is supplied to the console through a two conductor power cord terminating in a two pole female plug. The console-to-


SWELL TREM.SWITCH
(CHORUS)
TO PRE-AMPLIFIER
TO PRE-AMPLIFIER
GREAT TREM.SWITCH
(MAIN)
C5
C3
R3
R3
C3
C5
C2
SWELL
RHEOSTAT
GREAT
RHEOSTAT
C2
C4
R4
R4
C4
R2
R2
SWELL
TREMULANT
CONTROL
INPUT FROM SWELL
MATCHING TRANSFORMER
INPUT FROM GREAT
MATCHING TRANSFORMER
GREAT
TREMULANT
CONTROL

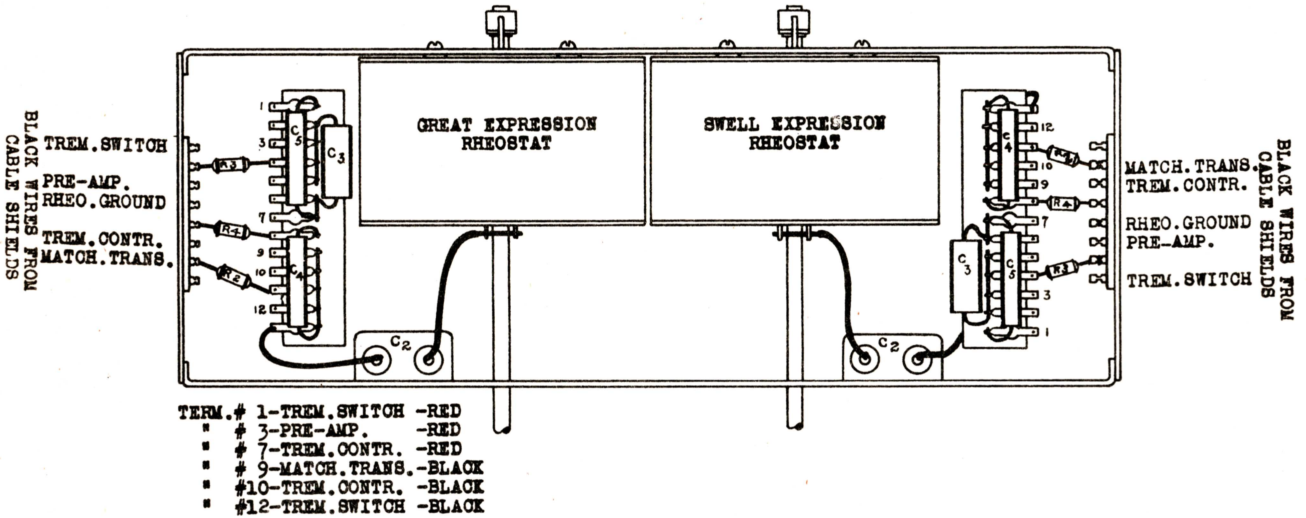
RESISTORS

R2	140,000	ohms
R3	140,000	"
R4	20,000	"

CONDENSERS

C2	.5	mfd.	200	volts
C3	.105	"	"	"
C4	.001	"	"	"
C5	.009	"	"	"

RHEOSTAT BOX WIRING
MODEL E CONSOLE
FIGURE 8.


BLACK WIRES FROM CABLE SHIELDS
TREM.SWITCH
PRE-AMP.
RHEO.GROUND
TREM.CONTR.
MATCH.TRANS.
GREAT EXPRESSION RHEOSTAT
SWELL EXPRESSION RHEOSTAT
C5
C3
C4
C2
R3
R4
R2
1
3
7
9
10
12

TERM.# 1-TREM.SWITCH -RED
" # 3-PRE-AMP. -RED
" # 7-TREM.CONTR. -RED
" # 9-MATCH.TRANS.-BLACK
" #10-TREM.CONTR. -BLACK
" #12-TREM.SWITCH -BLACK

RHEOSTAT BOX USED IN MODEL E CONSOLE

FIGURE 9.

cabinet cable terminates at the console in a six pole male plug. Both of these cables pass through a small opening provided at the end of the console and connect to the receptacles inside the terminal box.

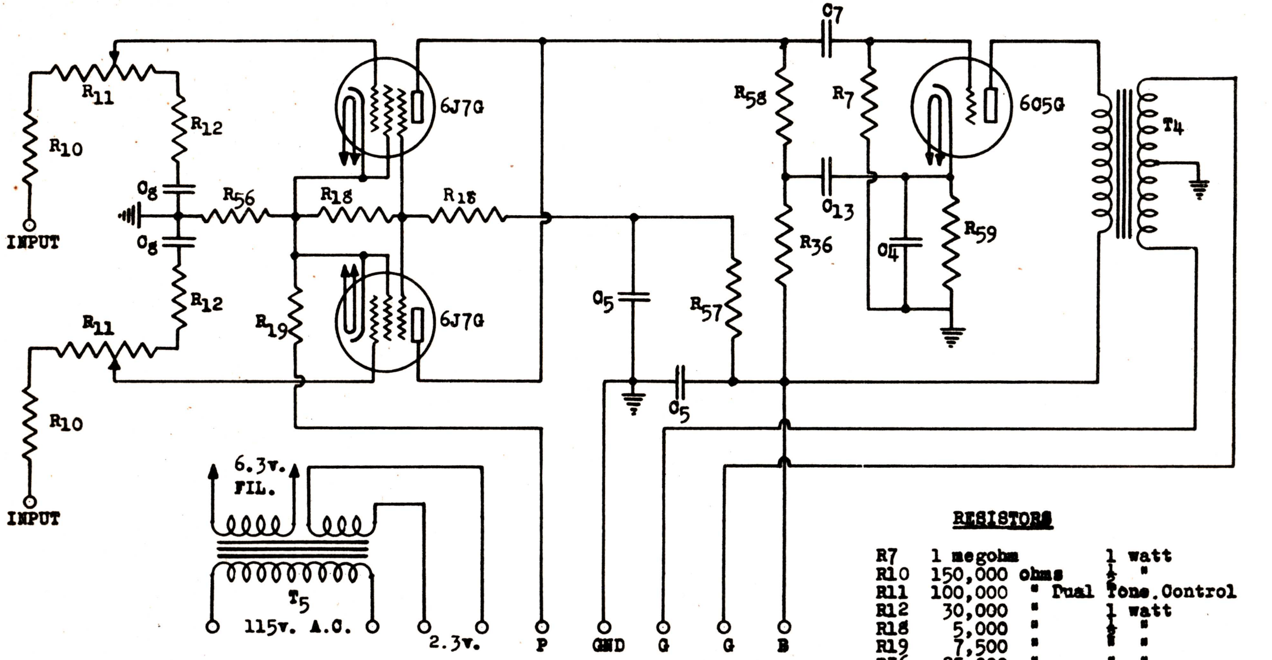
Adjustments

Pedal arms are set at the factory for average tension, but sometimes an organist will prefer pedals that are very stiff or very light in touch. Hammond pedal arms are adjustable, so any tension is possible. The adjustment is accomplished by removal of the top cover at the back of the keyboard and setting the tension nuts as desired.

Swell or expression pedals may also be adjusted for tension. A clamp bearing is provided on the pivot shaft of each swell pedal on the Model E. Adjustment is accomplished by setting the tension nuts located on the rear of the clamps. When the nuts are tightened the clamps compress coil springs and thus increase the pedal tension.

The Organ Bench

The Model E bench (see page 7 of the introductory section for illustration and dimensions) is larger than the Model B bench. In design and finish it matches the console.


INPUT
INPUT
R10
R10
R11
R11
R12
R12
C8
C8
R56
R18
R18
R19
6J7G
6J7G
C7
R58
R7
C13
R36
C4
R59
6C5G
T4
C5
C5
R57
6.3v.
FIL.
T5
115v. A.C.
2.3v.
P
GND
G
G
B

RESISTORS

R7	1 megohm		1	watt	
R10	150,000	ohms	½	"	
R11	100,000	"	Dual Tone.Control		
R12	30,000	"	1	watt	
R18	5,000	"	½	"	
R19	7,500	"	"	"	
R36	25,000	"	"	"	
R56	265	"	1	"	
R57	20,000	"	10	"	Wire Wound
R58	350,000	"	1	"	
R59	2,700	"	1	"	

TRANSFORMERS

T4	Output transformer
T5	Filament Transformer

CONDENSERS

C4	1	mfd.	200v.
C5	4	"	400v.
C7	.05	"	400v.
C8	.004	"	200v.
C13	1	"	400v.

USED IN MODEL E CONSOLE

- PRE-AMPLIFIER -

FIGURE 10.

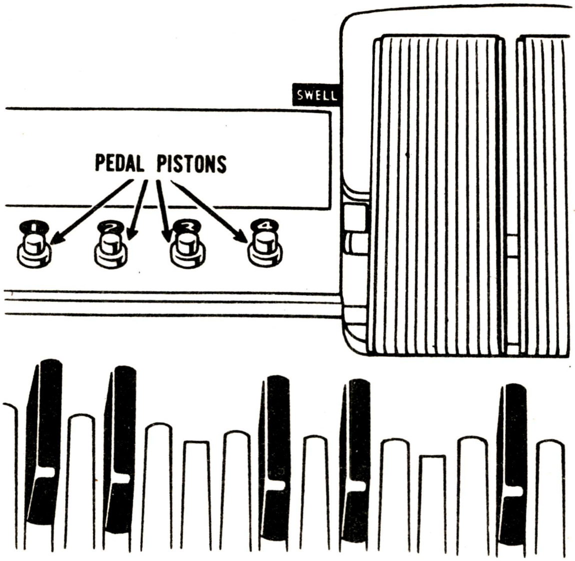

SWELL
PEDAL PISTONS
1
2
3
4

FIGURE 11.

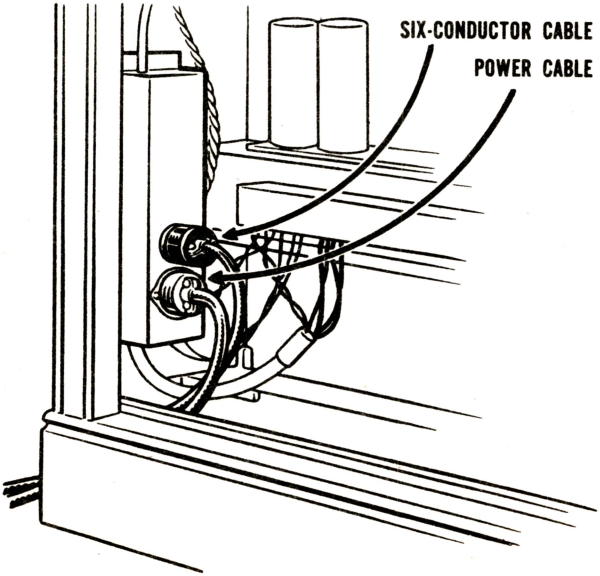

SIX-CONDUCTOR CABLE
POWER CABLE

FIGURE 12.

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 2

ACOUSTICS - THE PART THEY PLAY IN HAMMOND ORGAN INSTALLATIONS

HAMMOND INSTRUMENT COMPANY
2915 N. Western Ave.
Chicago, Ill.

10/15/42

Printed in U.S.A.

INSTALLATIONS IN GENERAL

The proper installation of a Hammond organ requires the careful observance of four primary rules:-

1. The organ should furnish AMPLE POWER.
2. The sound energy from the organ should be EVENLY DISTRIBUTED.
3. The console and tone cabinets should be so located in relation to each other and to the audience, choir, soloists etc., that a PROPER TONAL BALANCE is accomplished.
4. The organ tone should be PROPERLY REVERBERATED.

The observance of these rules with due consideration to the particular use for which the instrument is required will insure the best possible installation in any type of enclosure. These rules will be discussed in detail in the following pages.

POWER

There are so many factors which have a bearing on the amount of power or sound energy necessary for best musical results in a given enclosure that an accurate formula for determining the required power in all cases would be too cumbersome for everyday use. Experience has shown that it is very seldom that too much power equipment is specified. Therefore, if there is doubt as to the sufficiency of power equipment for any installation it is reasonably safe to double this amount. This will greatly improve the musical quality of the instrument and eliminate overloading of the speakers. Some of the factors which have a bearing on the amount of power required in any enclosure are size and shape of the enclosure, placement of power equipment, amount and location of sound absorbing materials including persons present in the enclosure. The use for which the organ is desired also has a bearing on the power required: for example, an organ to be used primarily to support congregational singing would require more power than one that is to be used mainly for accompaniment of soloists or light entertainment.

The following conditions in an enclosure, therefore, usually indicate that more than average power equipment may be required:

1. When the area of the boundaries of the enclosure is great in proportion to the volume of the enclosure. Thus, an enclosure of irregular shape having numerous alcoves, etc., would require more power than one of cubical shape.
2. When the power equipment is located in a position where considerable sound absorption takes place before the music reaches the listener. Power equipment in a poorly designed or constructed organ chamber is an example.
3. When acoustical correction materials are used on walls or ceiling, when heavy drapes are present and carpets are used for floor covering.
4. When seating capacity is high for the size of the enclosure. For practical purposes an open window is considered as an area of 100 percent absorption of sound. A single person absorbs about as much sound as four square feet of open window. Therefore, an audience of 1,000 people will have the effect on music volume of an open window area of 4,000 square feet as compared with the volume heard when the enclosure is empty. To offset this absorption, a disproportionately greater amount of power cabinet equipment must be used.

DISTRIBUTION

The sound energy from the organ should be distributed as evenly as possible throughout the enclosure. In order that this may be accomplished, it is important that the sound be distributed in the auditorium above the listeners and that a large percentage of the sound reaching the listener is by numerous reflections from the walls and ceiling. Direct projection as well as direct reflection from the speakers should not reach the listener. Focusing effects of curved surfaces such as barreled ceilings often cause difficulty in sound distribution unless the power equipment is so located as to reduce the direct sound energy that reaches these surfaces.
It must be remembered that although sound is reflected in a manner similar to light, the reflecting surface must be large in relation to the wave length of the sound. Therefore, a reflecting surface of a given size will reflect sounds above a certain frequency, while sounds of lower frequency will be diffracted or spread out. To reflect fully the lower tones of the organ a reflector thousands of square feet in area is necessary. This, together with the fact that different materials absorb sounds of certain frequencies more than others explains why identical tone colors produced in different enclosures will sound very different to the ear.

BALANCE

The placement of console and tone cabinets should be carefully planned so that the following conditions are fulfilled:
1. The organ should sound as loud or slightly louder to the organist at the console than it does to the audience.. This allows the organist to accurately judge the musical effect he is producing and make any necessary corrections before the audience appreciates the need for them. It also reduces the tendency of playing too loud which is usually evident when the organist hears the organ at a lower level than the audience.
2. The organist should hear the organ and the choir with the same relative loudness that the audience hears them, otherwise a perfect tonal balance between organ and choir from the organist's point of hearing will result in an unbalanced effect as heard by the audience. When we refer to the choir we also include instrumental groups or soloists who may have occasion to perform in conjunction with the organ.
3. The tonal equipment of the organ should be so located that the choir, while singing, has adequate support from the organ when played at accompaniment volume. They should not, however, hear the organ so loudly as to have difficulty in singing with it. Good tonal balance and ease of performance should result if the average distance between choir and tone cabinets is about the same distance as between tone cabinets and organist.
4. The audience should hear the choir and the organ as a balanced ensemble, and the tone cabinets should be so placed that the choir voices will not be obscured by the organ tones.

REVERBERATION

Reverberation is the prolongation or persistence of sound by reflection, what we usually mean by "echo". It is measurable by the interval of time required for the sound to decay to inaudibility after the source of the sound has been stopped. It is present in a varying degree in all enclosures and most types of music are more pleasing to the ear when accompanied by a certain amount of reverberation. It is also the most important single factor to be considered in planning an organ installation as proper reverberation makes it easier to attain all of the other requirements necessary for a perfect installation.

In a Hammond organ installation, the proper amount of reverberation may be secured in three ways:
1. By the successive reflections of the sound by the boundaries of the auditorium.
2. By the Hammond Reverberation Control.
3. By placing the tone cabinets in a chamber, the boundaries of which cause the organ tones to reverberate before reaching the auditorium.

REVERBERATION IN THE AUDITORIUM

The reverberation that results from the successive reflections of sound back and forth by the boundaries of the auditorium itself is most desirable from the installation engineer's point of view. (By auditorium we mean any audience room such as a church or concert hall.)
In a reverberant auditorium less power is necessary and problems of sound distribution are greatly simplified and, therefore, the best possible musical results are usually obtained as a matter of course. unfortunately, however, the reverberation characteristics of an auditorium usually are not alterable by the installation engineer, and he must accept them, good or bad as the case may be.
A reverberation time of one second when a two thirds capacity audience is present is usually sufficient if reasonable care is taken in locating the organ equipment for proper distribution and balance although a slightly longer reverberation time is often desirable. It must be remembered that the reverberation time in any enclosure is greatly reduced when an audience is present. In general, the higher the ceiling of the auditorium, the less effect the presence of an audience has on the reverberation time; however, this effect is always considerable. If the natural reverberation in the auditorium is insufficient for best musical resultsfrom the organ, another medhod must be used to properly reverberate the organ tones.

HAMMOND REVERBERATION CONTROL

The Hammond Reverberation Unit provides an effective means of securing proper reverberation in all types of installations where the natural reverberation in the auditorium is insufficient. Experience has shown that best installations in homes, radio studios, mortuaries, and small churches include a tone cabinet equipped with reverberation control. It may also be used to improve the effectiveness of the organ in auditoriums where considerable natural reverberation is present, but where this natural reverberation is characterized by an objectionable echo occurring after the organ tones have seemingly ceased. The Hammond Reverberation Unit will not eliminate an echo or reduce the natural reverberation time, but will often make this natural reverberation more pleasing to the ear by "filling in" that period between the time the organ tones seem to cease and the echo occurs. The Hammond Reverberation Unit will not add to the reverberation time in auditoriums already having excessive natural reverberation.
As the reverberation unit is connected to the electrical system of the organ and provides reverberation at the source of sound rather than after the sound comes from the speakers, it allows the installation engineer to place the tone cabinets for best results in balance and distribution without the necessity of compromise for reverberation considerations. The use of this device also eliminates the necessity of costly reverberation chambers, and by allowing the tone cabinets to be so located as to minimize sound energy losses, a saving in the amount of necessary power equipment is often effected. A further advantage is that the reverberation time may be regulated for best musical results after the organ is installed.

With the use of the Hammond Reverberation Unit a good organ installation should always result if the tonal equipment is placed to give even distribution and proper tonal balance.

REVERBERATION CHAMBERS

When it is desired to conceal the organ tone cabinets and there is adequate space available, a properly designed reverberation chamber may be very effective in supplying reverberation for the organ tones. In many cases, however, the space allotted for use as a reverberation chamber is anything but ideal, and often, because of structural limitations, little can be done to improve the effectiveness of the chamber other than to make minor correction. The following principles of reverberation chamber design are given for guidance in properly evaluating the good and bad characteristics of a given chamber and in making such changes as will improve the effectiveness of the chamber as much as possible.

SIZE

As the reverberation time increases as the size of the chamber increases, the chamber should be as large as possible. Experience has shown that practically the only exceptions to this rule are when the shape of the chamber may be improved by reducing its size or when the tone opening cannot be made large enough in proportion to the size of the chamber. For best musical results the chamber should be at least 800 cubic feet in volume. The dimensions of the chamber are in most cases ideal if they are in the ratio of approximately 2 : 3 : 4½. A chamber of equal volume but more cubical in form would have a longer reverberation time, while a chamber of less cubical form would have a shorter reverberation time; however, dimensions in the above ratio are usually most desirable. Chambers of complex shape or chambers of regular shape whose greatest dimension is more than three times its least dimension should be avoided.

CONSTRUCTION AND FINISH

All boundaries of a reverberation chamber should be of exceptionally rigid construction. Concrete or heavy tile is ideal. If the chamber is to be of frame construction the studs should not be over fourteen inches on centers. Lath should be very securely nailed and the plaster should be hard and given a smooth finish coat.

TONE OPENINGS

The reverberation time of an organ chamber is greatly influenced by the size of the tone opening. For a chamber of given dimensions, the reverberation time is increased as the area of the tone opening is reduced. A large chamber, therefore, may have a large tone opening and still furnish sufficient reverberation, whereas a small chamber might require a very small opening. A chart is shown in Figure 1, giving the area of tone opening required to furnish one second reverberation time when the volume of the chamber is known. This chart is for chambers with dimensions in the ratio of 2 : 3 : 4½ only; however, in practice the areas of tone opening shown are generally satisfactory.

The tone opening should be located in the largest wall surface of the chamber if possible, and preferably near the center of the wall area.

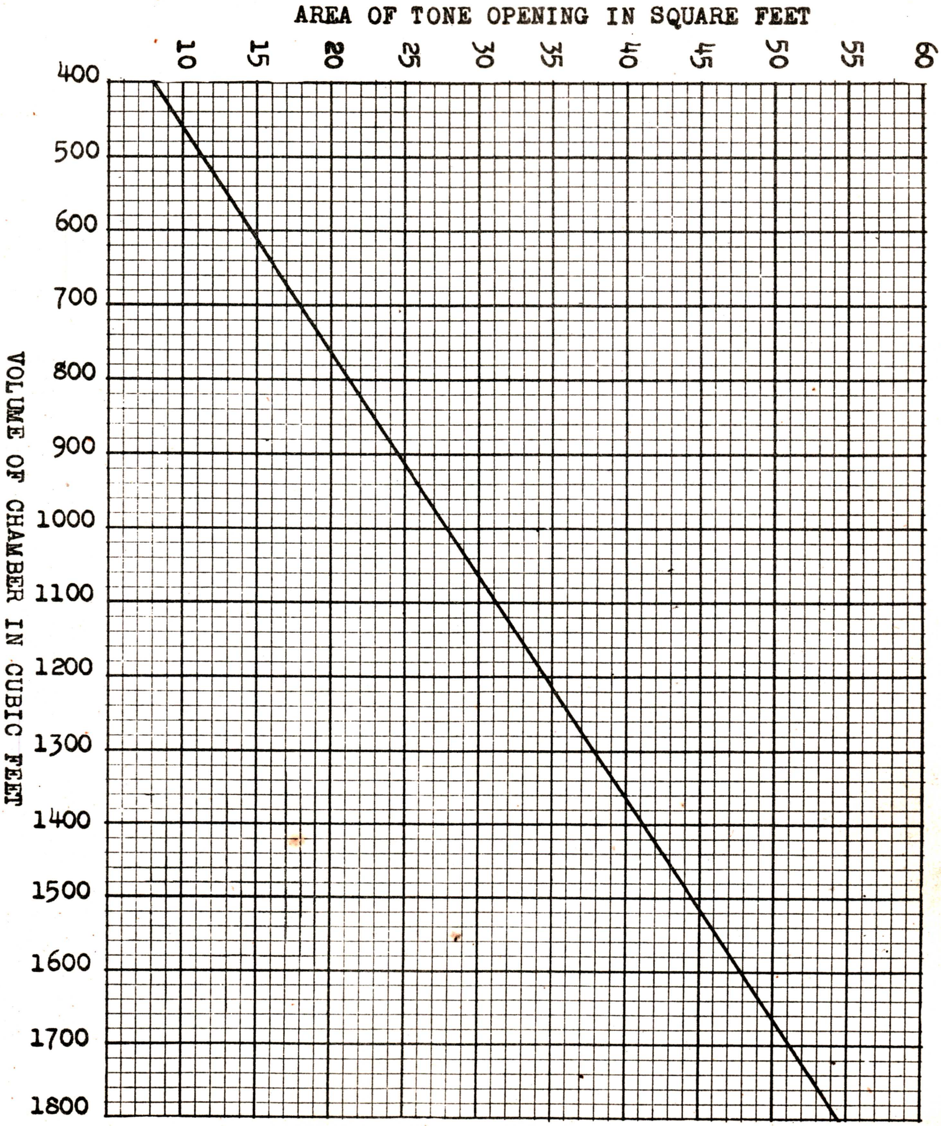


CHART SHOWING SIZE OF TONE OPENING REQUIRED
FOR REVERBERATION TIME OF ONE SECOND
FOR CHAMBERS WITH DIMENSIONS IN RATIO OF 2 : 3 : 4.5

FIGURE 1.

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 3

CABLE AND PLUG SPECIFICATIONS

HAMMOND INSTRUMENT COMPANY
2915 N. Western Avenue
Chicago, Illinois

Revised 2.16.42

CABLE AND PLUG SPECIFICATIONS

Consoles are shipped from the factory equipped with cables sufficient for ordinary installations having a single tone cabinet. For installations where the console is located an unusually long distance from the tone cabinet, additional 6 conductor cable should be ordered. For installations having two or more tone cabinets, cables must be ordered to connect between cabinets or, in the case of an echo organ, to connect console to the echo tone cabinet.

1. Console. The console is equipped with a 15 foot 2 conductor power cord for connecting console to AC wall outlet and a 35 foot 6 conductor console to cabinet cable with 6 pole fittings to connect console and first power amplifier. If console is equipped with echo switch, a standard 5 conductor coupling cable of required length must be ordered separately to connect console and echo tone cabinet. This cable has a 5 pole male connector at the console end and a 6 pole female connector at the end which attaches to the echo power amplifier.

2. 20 watt cabinet. This cabinet has a single power amplifier and two speakers. A 6 pole male connector is provided for attaching cable from console, cable from previous power amplifier or an A.C. power cord as circumstances require. A 5 pole female connector is provided for attaching succeeding tone cabinets or for signal input when separate A.C. power is to be supplied at the 6 pole connector. If cabinet is equipped with reverberation unit a special 6 conductor coupling cable is furnished for connecting reverberation pre-amplifier and power amplifier. Proper connections are shown on instruction card attached to cabinet.

3. 40 watt cabinet. This is the double strength cabinet containing 2 power amplifiers and 4 speakers. Each power amplifier is identical to the power amplifier used in the 20 watt cabinet and a 5 conductor coupling cable is furnished for interconnecting them. Succeeding cabinets may be connected to the 5 pole female connector in the second amplifier.

Types of Cable and Plugs Used

1. 6-conductor console-to-cabinet cable - Used only between the console and first power amplifier. It consists of two signal or grid conductors, two A.C. conductors, and one "B" voltage conductor enclosed in a woven shield. This shield, as ground, forms the sixth conductor.

2. 5-conductor cabinet-to-cabinet-cable - Used for connection between the first and second amplifiers and between the two amplifiers in each additional cabinet. It is identical with the 6-conductor cable except that the shielded brown wire is replaced by an unshielded yellow wire serving as ground. No "B" conductor is needed because the first power amplifier supplies adequate current for the pre-amplifier.

The 5 and 6-conductor cables are manufactured specially for Hammond Instrument Company and are approved by the Underwriters' Laboratories for use with the organ. Their construction is as follows:

#1. No. 16 stranded conductor with 1/32 inch of 30% rubber insulation, grey glazed cotton code braid.

#2. Same as above, with blue glazed cotton braid.

#3. No. 20 conductor with 1/32 inch wall of 30% rubber, brown glazed code braid, shielded with a close tinned copper shield.

#4. Above shield serves as one of the conductors.

#5 & 6. A twisted pair of No. 20 conductors, with 1/64 inch of 30% rubber insulation, twisted with a right hand lay, approximately one complete twist per inch, and insulated over all with a 1/64 inch jacket of 30% rubber with an outside diameter of .19 inch.

The four assembled conductors comprising this cable are then made up with a left hand lay, using jute and cotton filler to round out the assembly. The entire assembly is braided over all with fine cotton braid and covered with a rubber jacket of 40% brown rubber to an outside diameter of .49 inch.

3. 3-conductor cabinet to cabinet cable. This is standard 3-conductor indoor telephone cord. It is used for connection between power cabinets when external power circuits are employed. It consists of a green conductor with red tracer and a green conductor with (yellow or green) tracer for grid wires, and a green conductor for ground.

Methods of Connecting Extra Cabinets

A maximum of 560 watts may be supplied to tone cabinets from the console A.C. supply line. If total tone cabinet power requirements exceeds this amount, part of the cabinet equipment must be supplied from a separate A.C. source. Failure to do this may result in clamage to the power circuit of the console. Figure 1 shows a single tone cabinet connected to console requiring A.C. supply at console only.

Maximum wattage requirements for tone cabinet equipment are as follows:

Power amplifier	200 watts
Rotor tremulant	24 watts
Reverberation pre-amplifier	10 watts

Actual tone cabinet wattage requirements are stamped on console and tone cabinet name plates.

When the total tone cabinet A.C. consumption exceeds 560 watts, external power connections should be made for extra equipment above this amount. Power cords for this purpose may be purchased from the factory. Usually one power cord is used for each extra tone cabinet. For temporary use they may be plugged into the most convenient A.C. outlet.

As a permanent measure in large installations, a switch may be placed near the console for the extra equipment. A much better arrangement, however, consists of a small relay switch. Figure 2 illustrates the use of a relay spliced into the 5-conductor cabinet-to-cabinet cable. Figure 3 shows the wiring arrangement. This relay, an Allen-Bradley, type A-107, may be purchased from your electric supplier or direct from Hammond Instrument Company.

In very large installations it will be necessary to supply extra power cords, because the conductors in the organ cable are not designed to carry more than three amplifiers. In these cases three conductor cable carries the signal between cabinets. Figure 4 shows an installation of four 40-watt cabinets with a relay connected as in Figure 5. The type A-107 relay, rated at 10 amperes, will operate as many as five amplifiers. For more than five amplifiers a type A-109 relay rated at 25 amperes should be used.

Plug and Cable Connections

Cables are supplied with small five or six pole plugs and receptacles. They are sturdy and serviceable and will serve very satisfactorily for the average installation.

When it becomes necessary to order extra lengths of cable, be sure to specify the type of plugs required at each end in order that they may be supplied all connected ready for use. If you solder plugs yourself, follow carefully the diagrams in Figure 6.

For permanent installations, when the cables are to be installed in conduit, the special fittings described in part 3-A should be used.

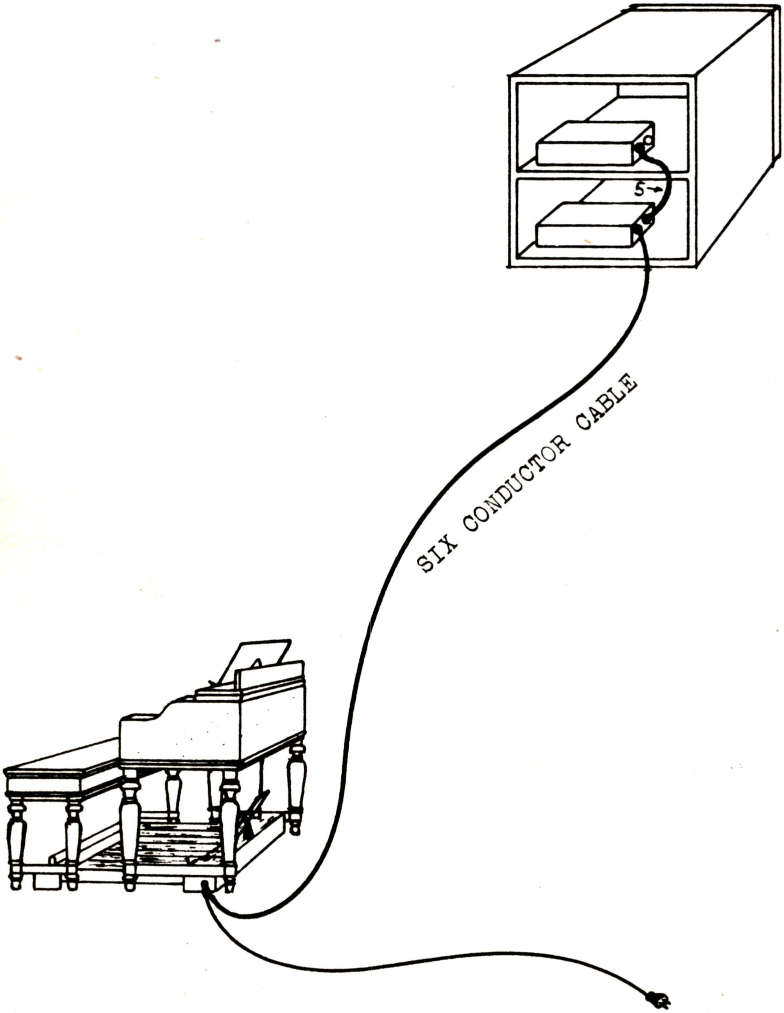

5
SIX CONDUCTOR CABLE

FIGURE 1.

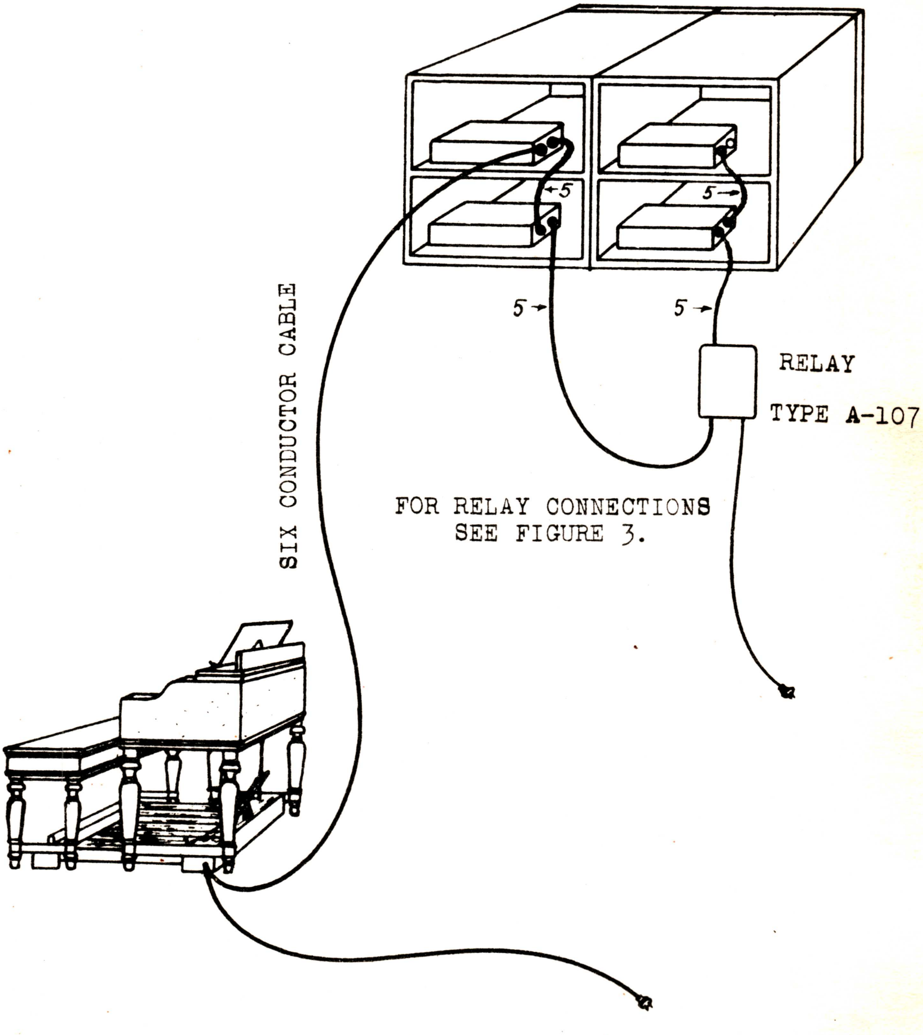

SIX CONDUCTOR CABLE
5
5
5
5
RELAY
TYPE A-107
FOR RELAY CONNECTIONS
SEE FIGURE 3.

FIGURE 2.

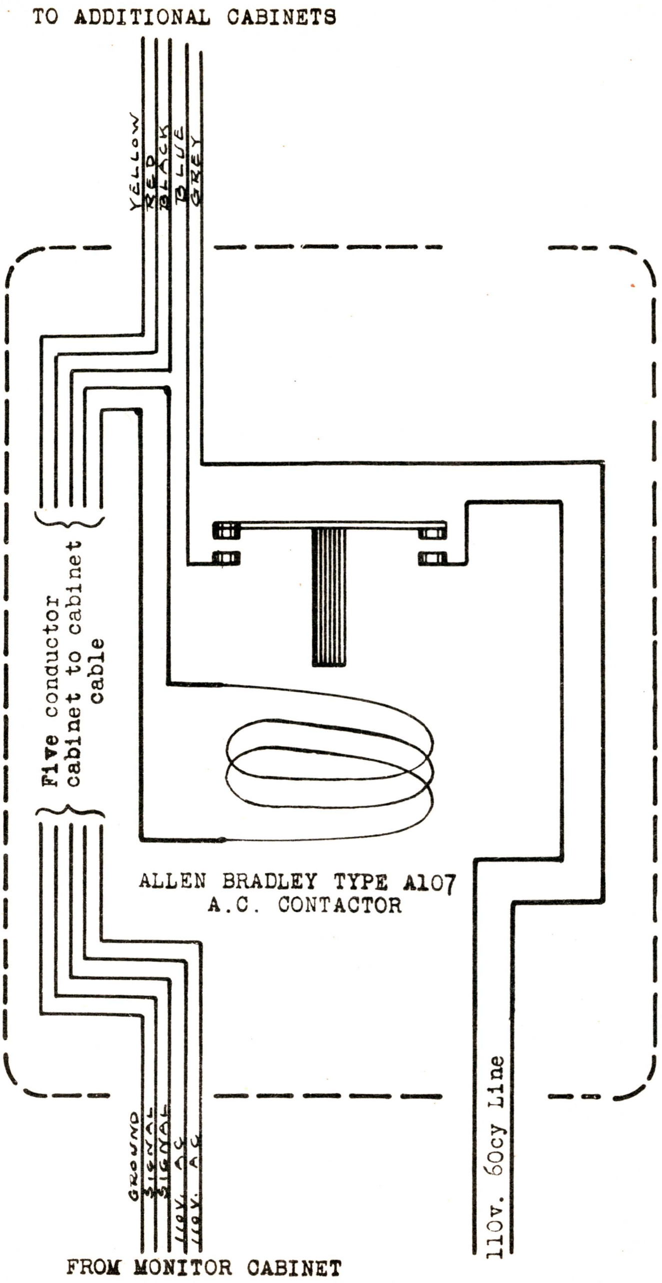

TO ADDITIONAL CABINETS
YELLOW
RED
BLACK
BLUE
GREY
Five conductor cabinet to cabinet cable
ALLEN BRADLEY TYPE A107
A.C. CONTACTOR
GROUND
SIGNAL
SIGNAL
110V. AC
110V. AC
110v. 60cy Line
FROM MONITOR CABINET

FIGURE 3.

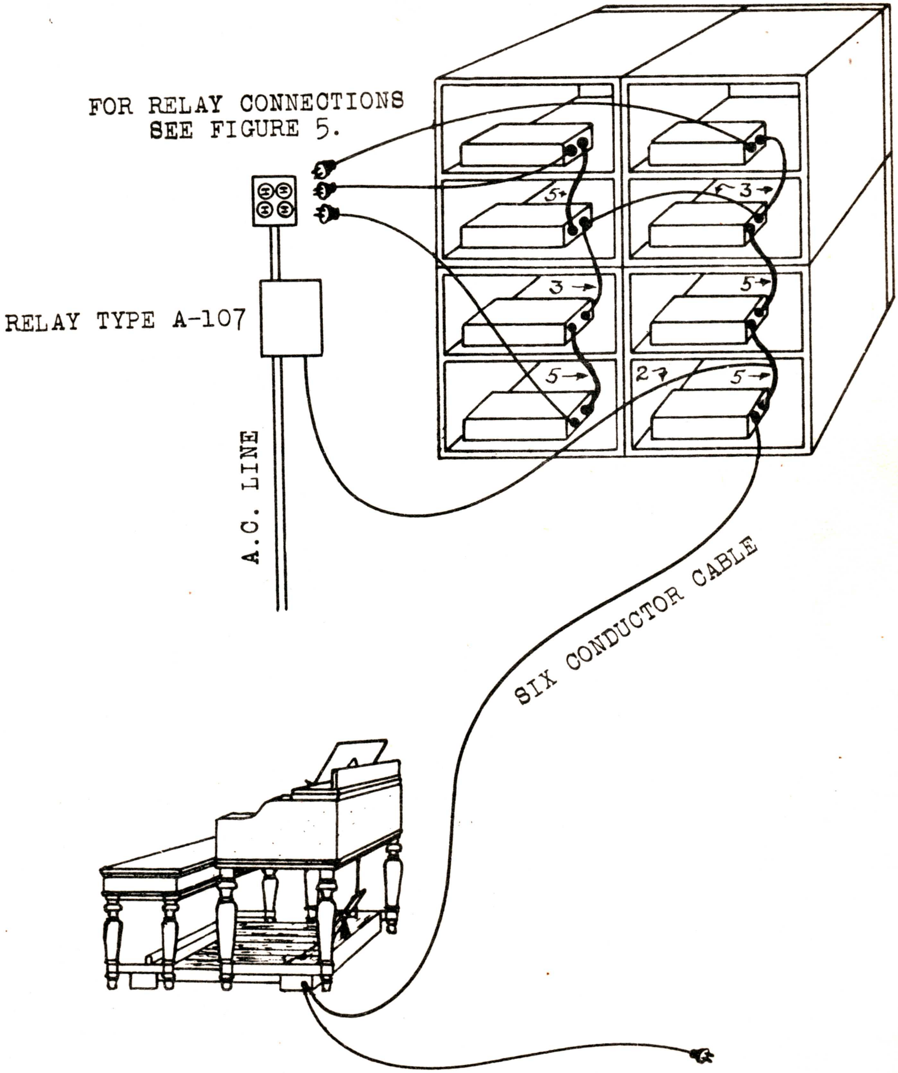

FOR RELAY CONNECTIONS
SEE FIGURE 5.
RELAY TYPE A-107
A.C. LINE
SIX CONDUCTOR CABLE
5
3
3
5
5
2
5

FIGURE 4.

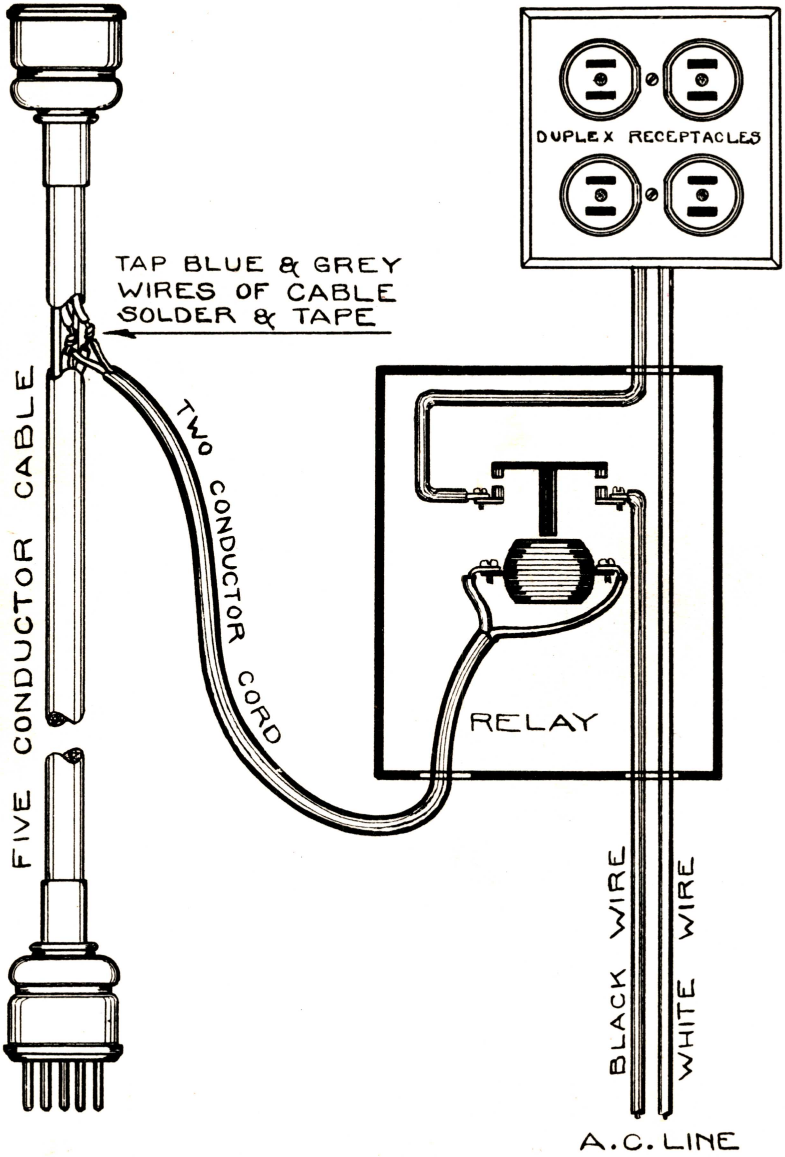
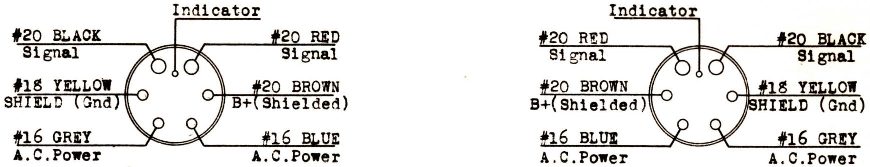

DUPLEX RECEPTACLES
TAP BLUE & GREY WIRES OF CABLE SOLDER & TAPE
FIVE CONDUCTOR CABLE
TWO CONDUCTOR CORD
RELAY
BLACK WIRE
WHITE WIRE
A.C. LINE

FIGURE 5

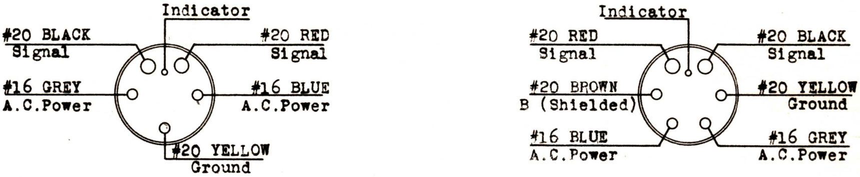
(B3-84301) G 40-28-1


Indicator
#20 BLACK
Signal
#20 RED
Signal
#18 YELLOW
SHIELD (Gnd)
#20 BROWN
B+(Shielded)
#16 GREY
A.C.Power
#16 BLUE
A.C.Power
Indicator
#20 RED
Signal
#20 BLACK
Signal
#20 BROWN
B+(Shielded)
#18 YELLOW
SHIELD (Gnd)
#16 BLUE
A.C.Power
#16 GREY
A.C.Power

6 POLE PLUG

6 POLE RECEPTACLE

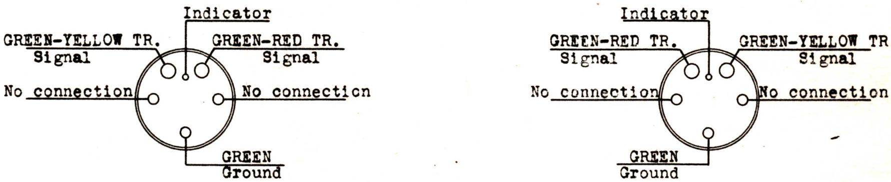
6 CONDUCTOR CONSOLE-TO-CABINET CABLE


Indicator
#20 BLACK
Signal
#20 RED
Signal
#16 GREY
A.C.Power
#16 BLUE
A.C.Power
#20 YELLOW
Ground
Indicator
#20 RED
Signal
#20 BLACK
Signal
#20 BROWN
B (Shielded)
#20 YELLOW
Ground
#16 BLUE
A.C.Power
#16 GREY
A.C.Power

5 POLE PLUG

6 POLE RECEPTACLE

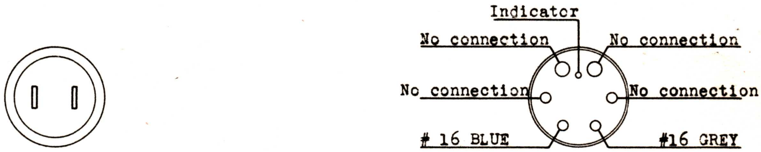
5 CONDUCTOR CABINET-TO-CABINET OR AMPLIFIER-TO-AMPLIFIER COUPLING CABLE


Indicator
GREEN-YELLOW TR.
Signal
GREEN-RED TR.
Signal
No connection
No connection
GREEN
Ground
Indicator
GREEN-RED TR.
Signal
GREEN-YELLOW TR.
Signal
No connection
No connection
GREEN
Ground

5 POLE PLUG

5 POLE PLUG

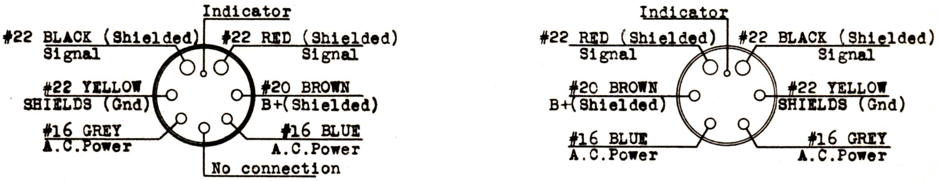
3 CONDUCTOR CABINET-TO-CABINET OR AMPLIFIER-TO-AMPLIFIER SIGNAL CABLE


Indicator
No connection
No connection
No connection
No connection
# 16 BLUE
#16 GREY

STANDARD ATTACHMENT PLUG
FOR CONNECTION TO A.C.OUTLET

6 POLE RECEPTACLE

2 CONDUCTOR AMPLIFIER POWER CORD


Indicator
#22 BLACK (Shielded)
Signal
#22 RED (Shielded)
Signal
#22 YELLOW
SHIELDS (Gnd)
#20 BROWN
B+(Shielded)
#16 GREY
A.C.Power
#16 BLUE
A.C.Power
No connection
Indicator
#22 RED (Shielded)
Signal
#22 BLACK (Shielded)
Signal
#20 BROWN
B+(Shielded)
#22 YELLOW
SHIELDS (Gnd)
#16 BLUE
A.C.Power
#16 GREY
A.C.Power

7 POLE PLUG

6 POLE RECEPTACLE

6 CONDUCTOR REVERBERATION PREAMPLIFIER-TO-POWER AMPLIFIER COUPLING CABLE

CABLE CONNECTOR WIRING

FIGURE 6.

THE HAMMOND ORGAN

Part 4 A MANUAL FOR THE SERVICE TECHNICIAN

ANALYSIS OF TROUBLES

HAMMOND INSTRUMENT COMPANY
2915 North Western Avenue
Chicago, Illinois

Printed in the United States of America

ANALYSIS OF TROUBLES

For convenience in locating trouble, this section is divided into three parts: the Amplification System, the Electrical Circuit ahead of the Amplification System, and Mechanical Difficulties. It should be relatively simple to allocate the trouble to one of these sources, then to ascertain by systematic analysis the exact source.

The three systems will be treated separately, and the parts of the amplification system which are obviously most susceptible to troubles will be considered first.

If the Output Signal on All Frequencies is Dead.

In a case of this kind the trouble should be localized into one of the following sections:

1. Circuit ahead of the pre-amplifier.
2. The Pre-amplifier.
3. The Power-amplifier.

Check the generator first to see that it appears to be operating properly, then follow the steps outlined below:

1. Touch the grid cap of the 57 tube (6J7 G in Model E) without removing the shield. If a very loud hum is heard, the preamplifier and power amplifier are operating, and the trouble must be ahead of the pre-amplifier.
2. If the above test does not result in a hum, remove one of the power amplifier 56 tubes. A loud click in the speakers indicates that the power amplifier is operating. The trouble must then be in the pre-amplifier or the console-to-cabinet cable.
3. The absence of a click when the 56 tube is removed indicates that the trouble lies in the power amplifier.

A- The Amplification System

It is suggested that amplifiers used in the Hammond Organ be tested with a conventional radio set analyzer with AC and DC voltage ranges up to 500 volts, and current ranges up to 100 milliamperes. With this flexibility the instrument may also be used as a tube tester and a line voltmeter. A resistance scale on the analyzer meter or a separate resistance meter with self-contained battery is useful for testing resistors in the amplifiers. It should have a scale reading up to 3 megohms.

Typical readings for an analyzer with a "1000 ohms per volt" meter are given below. The voltages may vary slightly if readings are taken with a meter of different sensitivity or with ranges in variance with those specified.

Weston Model 772 type 2 analyzer is satisfactory for all necessary tests of the organ, and when combined with a tube checker in Weston's Model 775 it is complete portable service set adequate for the Hammond technician.

POWER AMPLIFIER

Tube	Filament volts	Plate volts	Grid volts	Plate current
56	2.5 V. AC	140 (250 V. scale)	10 (50 V. scale)	2 ma.
2A3	2.5 V. AC	320	50 (50 V. scale)	35-40 ma.
5Z3	5 V. AC	450 V. AC	-	-

PREAMPLIFIER

56	2.5 V. AC	250 (250 V. scale)	9 (50 V. scale)	4 ma.
57	2.5 V. AC	50 (250 V. scale)	2 (50 V. scale)	0.5 ma.

Screen volts (57 tube) - 35 (50 volt scale)

If a discrepancy of 20% or more is noticed on any of the above readings, an investigation should be made of all parts which might affect it. Any resistor differing by as much as 30% from its rated value should be replaced. A condenser should be replaced if its capacity has dropped as much as 20%.

For testing both generator and amplifier condensers, a neon lamp type tester is very satisfactory. Such a tester should be capable of checking both electrolytic and paper condensers of capacities ranging from .001 to 30 microfarads. In every case, condensers must be disconnected before testing, otherwise the reading will be affected by other parts of the circuit.

All resistors are marked with the standard RMA color code. The colors represent numbers as follows:

0- black
1- brown
2- red
3- orange
4- yellow
5- green
6- blue
7- violet
8- grey
9- white

The body color of the resistor is the first digit of its resistance value; the end color is the second digit; and the dot or center band represents the number of ciphers after the first two digits. If no dot or center band can be seen, then it is the same as the body color. For instance, the resistance for a red body, green end and orange dot or center band would be as follows: first digit 2, second digit 5, followed by three ciphers: thus, 25,000 ohms.

Chokes and audio transformers may be tested by reference to their direct current resistances given with the circuit diagrams. If a winding is broken, the resistance will be infinite, and a short circuit will be indicated by greatly reduced resistance. The power transformer and filament transformer may be checked by comparing their voltages with those given on the diagrams. It should be remembered that all given voltages are for 115 volt A.C. line and for any reduction in line voltages they will be correspondingly affected.

B- The Electrical Circuit Ahead of the Amplification System

This section of the chapter will be concerned with analysis of troubles which may appear in the tone generator, the key circuits, the matching transformer and the swell pedal and rheostat box, all of which comprise the electrical circuit ahead of the amplification system. The generator itself is a low impedance device and all connections associated with it may be identified by sight in that they are exposed. The matching transformer is a step-up type, and all connections from the high side of this transformer to the swell pedal and rheostat box and on to the pre-amplifier are shielded.

Troubles which are traceable to the tone generator will invariably appear as dead or weak frequencies. The following procedure will be helpful in locating the exact source of such troubles.

1. Depress A# preset key (piston #10 on Model E) on the upper manual.
2. Pull out #1 (brown) drawbar only in first of left hand drawbar group.
3. Starting at first or low C (frequency #1) test each note on upper manual successively. The last note at right end of keyboard is frequency #61.
4. Pull out #9 (white) drawbar only in this same group and starting at second C (frequency #61) test each note successively until the second F# from top of manual is reached. This is frequency #91, the highest frequency produced by the generator.
5. If all 91 notes sound and are approximately uniform in intensity, the generator is operating normally.
6. If there are dead or weak notes present, make a note of frequency numbers, then proceed to test the lower manual in the same manner.

Should any dead notes appear on the above test, proceed as follows:

1. Single dead (or weak) notes on one manual which do not appear at same point on other manual are usually traceable to faulty key contacts. May be corrected by adjusting the key contact shifters associated with both manuals and pedal switch. For more information on this feature see part 4-A of the manual.
2. A single dead note appearing at the same point on both manuals may be dead at the generator or may be caused by a broken wire or poor solder joint on one of the terminal strips. The generator proper may be tested for output by fastening a short length of wire to #4 bar on the pre-set panel and touching it to each lug on the generator terminal strip. If all sound, the cable wire or a soldered joint must be at fault.

Note

3. If the generator output is dead, the filter circuit is probably defective. Figure 1 illustrates the position of each filter transformer and condenser on the generator cover, and Figure 2 shows the connections to a typical filter. Each terminal of the filter should be tested by the method described in paragraph 2 above.
4. If the signal is dead at the magnet pick up coil terminal, even with the coil lead disconnected, either the coil is defective or the tone wheel is not turning. Should this test disclose a defective pick up coil it will be necessary that the complete generator be removed and returned to the factory for repairs. Replacement of such a coil necessitates dismantling the entire generator and should not be attempted in the field.
5. Should the trouble be mechanical, two frequencies will probably be dead on both manuals. By counting the frequencies as the manuals are tested as described previously and referring to figure 3, the exact location of the magnets associated with these frequencies will be found. If these two magnets are together, either one tone wheel is jammed against the magnet tip or the bearings are too tight to permit free rotation.

In figure 3, a dotted line indicates that the frequency numbers so connected are generated by two tone wheels on the same shaft and in the same compartment. In the case of frequencies 37, 38, 39, 40, and 41, only a single active tone wheel is on each shaft.

To make adjustments in a case of mechanical binding, the pre-amplifier and rheostat and terminal box must be loosened, and the swell pedal rod and the channel holding all of these assemblies must be removed. The preamplifier and terminal box may rest on top of the chorus generator during adjustments.

The actual adjustment is accomplished by raising the chorus generator sufficiently to gain access to the proper magnets, then adjusting the magnets for clearance. The Set screw holding each magnet in place may be loosened with a small wrench or longnose pliers. When the proper magnet is moved back slightly the dead note should sound.

To make the final adjustment, sound the note to be adjusted by holding a playing key down, tighten the magnet slightly and tap it very gently until it moves close enough to the tone wheel to bring the intensity up to that of adjacent notes. Then tighten the Set screw.

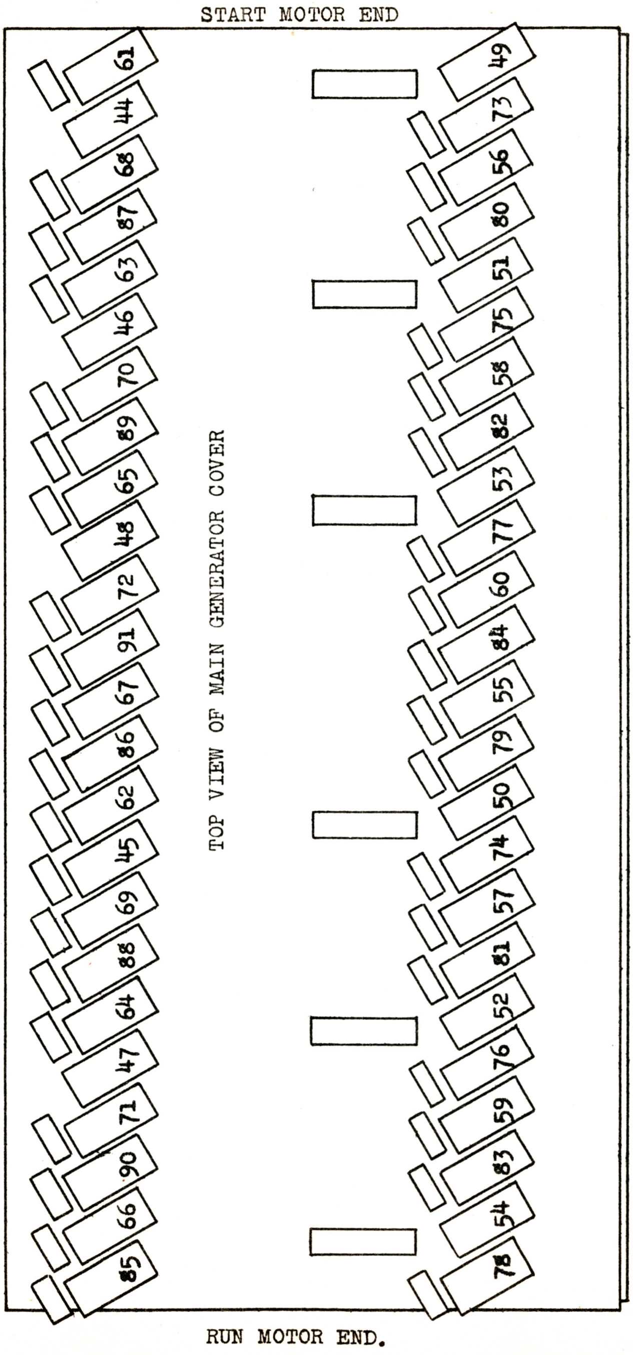
6. It is important that the service technician avoid testing the tone generator with an outside source of current, such as that supplied by a continuity meter. Serious damage to the sensitive filter transformers and permanent magnets may result if such outside sources of current are used. If the procedures outlined above are followed, all Note → necessary tests of the tone generator may be made with the currents supplied by the instrument itself.

C- Mechanical Difficulties and the Power Control Circuit

Moving parts in the organ are limited to the tone generator assembly, and precise construction together with adequate provision for thorough lubrication tends to minimize the difficulties which may arise here. The starting and synchronous running motors do not use brushes, so under ordinary conditions of use they will operate satisfactorily and will not require any attention. All rotating shafts are mounted in a special porous bearing surface and are continuously lubricated through a centralized system.

Other than the tone generator, the only action which may be classed as mechanical is that of the keys and switches. The possible troubles which may develop in the key action are treated in the following outlines of trouble analysis.

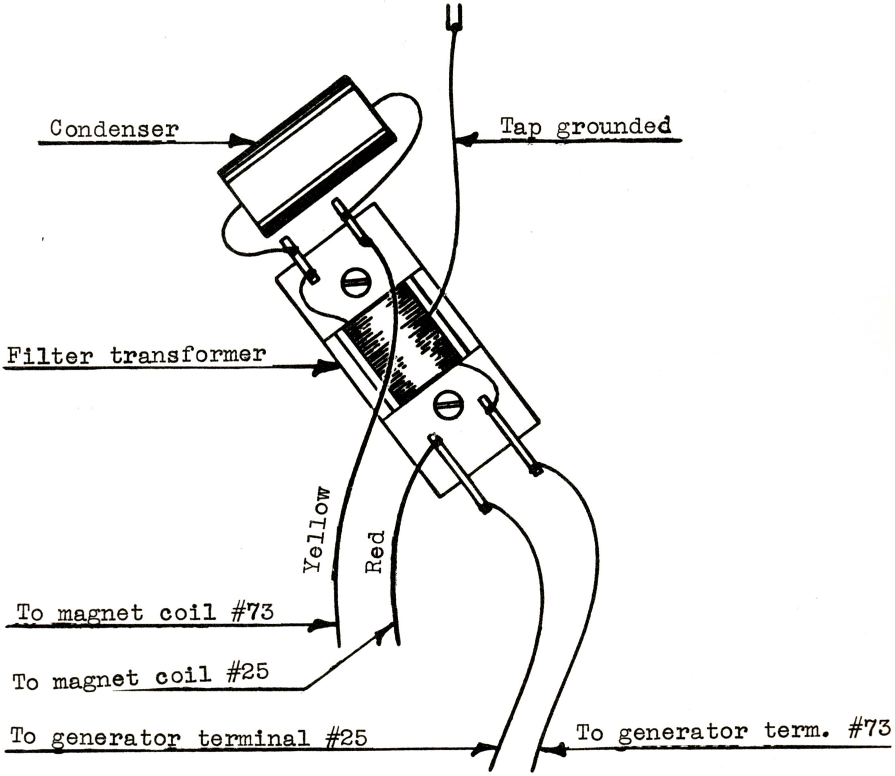
The power control circuit, inclusive of switches, power wiring, cables and plugs, is also included in this section. A defective switch will be relatively simple to trace, and other troubles in the power control circuit may be checked by a continuity tester consisting of a resistance meter and battery.


START MOTOR END
TOP VIEW OF MAIN GENERATOR COVER
61
44
68
87
63
46
70
89
65
48
72
91
67
86
62
45
69
88
64
47
71
90
66
85
49
73
56
80
51
75
58
82
53
77
60
84
55
79
50
74
57
81
52
76
59
83
54
78
RUN MOTOR END.

LOCATION OF FILTER TRANSFORMERS AND CONDENSERS.

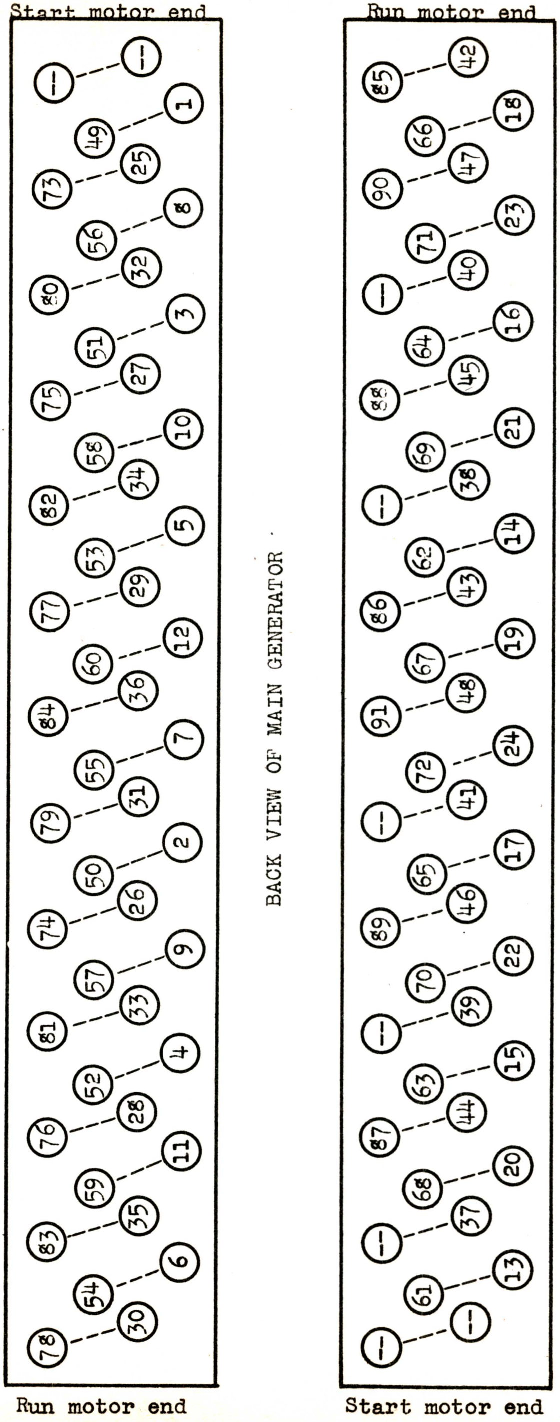
FIGURE 1.

(Numbers shown are frequency numbers)


Condenser
Tap grounded
Filter transformer
Yellow
Red
To magnet coil #73
To magnet coil #25
To generator terminal #25
To generator term. #73

TYPICAL FILTER CONNECTIONS

FIGURE 2.


Start motor end
—
—
49
1
73
25
56
8
80
32
51
3
75
27
58
10
82
34
53
5
77
29
60
12
84
36
55
7
79
31
50
2
74
26
57
9
81
33
52
4
76
28
59
11
83
35
54
6
78
30
Run motor end
Run motor end
85
42
66
18
90
47
71
23
—
40
64
16
88
45
69
21
—
38
62
14
86
43
67
19
91
48
72
24
—
41
65
17
89
46
70
22
—
39
63
15
87
44
68
20
—
37
61
13
—
—
Start motor end

BACK VIEW OF MAIN GENERATOR

FRONT VIEW OF MAIN GENERATOR

GENERATOR MAGNET LOCATIONS

FIGURE 3.

(numbers shown are frequency numbers)

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 4

ANALYSIS OF TROUBLES

A - Key Contact Shifters

Hammond Instrument Company,
2915 N. Western Avenue,
Chicago, Illinois

9.10.38

HAMMOND ORGAN KEY CONTACT SHIFTERS

If, after an organ has been in operation for a considerable period of time, the customer or organist complains that certain of the keys are scratchy, noisy or silent, this may be taken as evidence of possible dust particles lodged in the contacts. These contacts are made of platinum-iridium, the finest metal obtainable for the purpose. They are not susceptible to breakdown because of corrosion or wear, and they will not require any attention except in places where the instrument is subjected to excessive amounts of dust.

Upon the first appearance of scratchy or silent harmonics, the service man should strike the offending key in a rapid staccato manner fifteen or twenty times. This procedure usually dislodges the particles and clears the contacts. Be sure to try this procedure before resorting to the key contact shifters.

If the above adjustment does not correct the condition, then it will be necessary to adjust the key contact shifters. If the console is serial numbered above 995, follow the procedure outlined below. If the console is below 995 in number, it is not equipped with key contact shifters. This feature was incorporated in the organ to improve its operability under the conditions described above, and it is quite possible to install the shifter device in consoles not so equipped if it seems desirable. Write to the Organ Service Department of the Hammond Clock Company for details and cost of making installation of this key contact shifter.

Instructions for Use of Key Contact Shifters

Adjustment of key contacts is made by manipulating the contact shifters using the three slotted studs illustrated in Figure 1. Contact shifter A controls the contacts associated with the keys on the upper manual; contact shifter B controls the contacts associated with the keys on the lower manual; and contact shifter C controls the contacts associated with the pedal keyboard.

To shift the contacts:

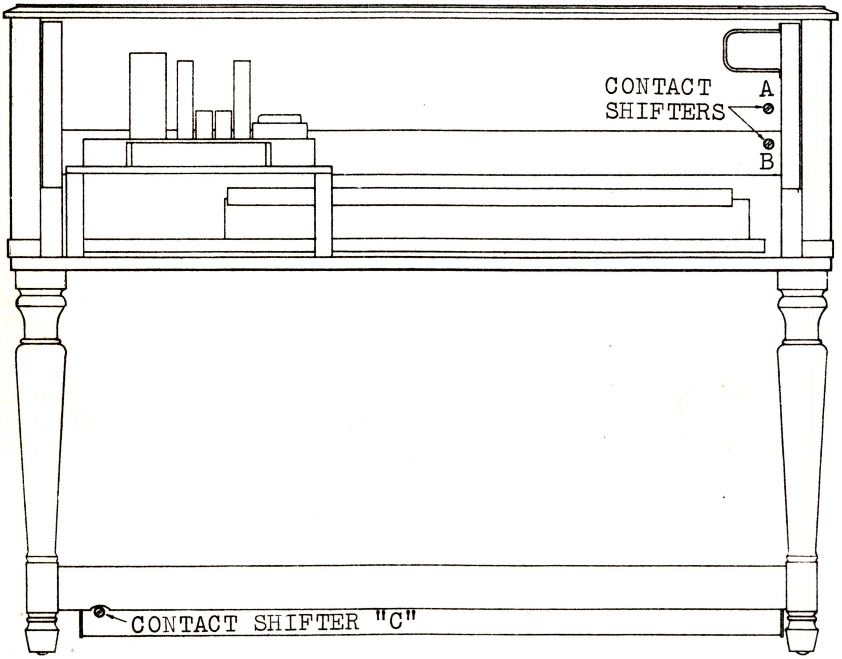
1 Turn the stud associated with the keyboard in question not more than one-eighth to one-fourth of a complete revolution in a counter-clockwise direction.

2. If all motion has been taken up in this direction, then turn the stud one complete revolution in a clockwise direction to take

up the play, and an additional one-eighth to one-fourth revolution, continuing in the clockwise direction, for the adjustment. This will move all contacts to a new position and should free all contacts from dust particles.

3. If any harmonic should still be scratchy or silent after an adjustment, this may be cleared up by striking the key fifteen or twenty times in the manner suggested above.

KEY CONTACT SHIFTERS



DRAWING SHOWS REAR VIEW OF CONSOLE WITH BACK REMOVED

FIGURE 1

Incorporated in consoles #995 and above.
Also in certain other consoles below this number.

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

Part 4
Analysis of Troubles

B - Dismantling Instructions

The Hammond Instrument Company
2915 N. Western Avenue
Chicago, Illinois

10/15/42 Printed in the United States of America

A. Removal of the Manual Chassis

1. Remove two cotter pins from chorus drawbar action. These are located on the pivoted metal triangle on the left side of the manual chassis blocks.

2. Remove four screws from left and right hand side panels of music rack. Tilt bottom of rack by lifting the side panels, then pull outward.

3. If console is equipped with an echo switch: Remove it by unscrewing switch knob and taking out four small machine screws around center of switch. Do not lose the metal shim and felt washer located at the back of the switch plate. Make sure you can identify the original position of the switch so the echo and main will not be reversed when re-installed.

4. Remove four chassis bolts (underneath console) and the two machine screws (under the front lower manual rail) that secure the entire manual chassis.

5. Disconnect all shielded cables leading into swell box. They are: Input to preamplifier, tremulant switch, tremulant control, matching transformer output.

6. Take off swell pedal rod by removing the swell cam pusher and removing screw on swell pedal arm.

7. Take off the rheostat box by removing the four machine screws that hold it to the channel.

8. Disconnect all wires to preamplifier terminal panel and remove the preamplifier entirely by taking out the four screws at the corners in the rubber cushions. Do not lose the metal spacers inside of the rubber cushions.

9. Take out the channel by removing the four bolts holding it at the ends.

10. Disconnect the ninety-one manual wires, three ground wires, three pedal drawbar wires (Red, Yellow, Orange) and the pedal filter wires. The pedal filter is located at the right on the manual chassis block.

11. At the power panel terminals, disconnect the six wires leading to the manual chassis "start" and "run" switches. These may be easily located by tracing the wires from the switches themselves.

12. The manual chassis can now be removed. Care should be used in sliding out the manual chassis because, due to frame construction, it will drop suddenly before it is entirely out of the console. Two men should be used to complete this operation as the chassis is too heavy to be handled with the necessary care by one man. Note: When the new chassis is installed, be sure to check the position of the oiling tubes. They must be centered on the small cups underneath on the generators.

2

B. Removal of the Main Generator

1. Take off eight hexagon head bolts, on both generators, with their associated spring and slotted washers, then remove the hexagon head nuts that act as generator retainers during shipment. On older models remove the eight cup washers.

2. Remove three cotter pins from chorus drawbar action, two at top on metal triangle and one near the switch.

3. Take out four screws from left and right hand side panels of music rack. Tilt bottom of rack by lifting the side panels, then pull outward.

4. If console is equipped with echo switch: Remove it by unscrewing switch knob and taking out four small machine screws around center of switch. Do not lose the metal shim and felt washer located at back of switch plate. Disconnect all wires on the echo switch panel near the preamplifier. Make sure that you are able to identify the original positions of these wires so the echo switch will not be reversed.

5. Remove the four chassis bolts (underneath console) and the two machine screws (under the front lower manual rail) that secure the entire manual chassis.

6. Disconnect all shielded cables leading into the rheostat box. They are: Input to the preamplifier, tremulant switch, tremulant control, and matching transformer output.

7. Take off swell pedal rod by removing the swell cam pusher and removing screw on swell pedal arm.

8. Remove rheostat box by taking out the four machine screws that hold it to the channel.

9. Disconnect all connections to preamplifier terminal panel and remove the preamplifier entirely by taking out the four screws at the corners in the rubber cushions. Do not lose the metal spacers inside of the rubber cushions.

10. Take out the channel by removing the four bolts holding it at the ends.

11. Unsolder (do not cut) twenty-four wires from the chorus switch terminal strip, counting from left to right. Now unsolder the remaining twelve wires, noting dual lug connections. (In resoldering these wires refer, if necessary, to Figure 6, Part 1B for guidance.)

12. Remove the ground strap between main and chorus generators. This is located near the center, rear of the chorus switch.

13. At the power panel terminals, unsolder the wires leading to the main generator start and run motors.

14. Remove the four bolts and nuts that hold the terminal panel to the chorus generator frame.

15. The chorus generator can now be swung to the left with one end on a chair or other suitable support. The other end can rest on the console.

16. Return now to the manual chassis and pull out all drawbars to eight and tilt the chassis from the front, as far as the top of the console will allow it to be tilted. Place suitable wedges of blocks on either side to hold it in this position.

17. Disconnect ninety-one manual wires, sixty-one pedal wires, four ground wires, three pedal drawbar wires (red, yellow, orange) and the pedal filter wires. The pedal filter is located at the right end on the manual chassis block.

18. The main generator can now be lifted and moved towards the rear of the console. Then by lifting the end of the chorus generator, the main generator will pass underneath and can be entirely removed.

C. Removal of the Chorus Generator

1. Take off four hexagon head bolts, with their associated spring and slotted washers, then remove the hexagon head nuts that act as generator retainers during shipment. On older models remove four cup washers.

2. Remove cotter pin located near the chorus switch on the drawbar action.

3. If console is equipped with an echo switch: Remove it by unscrewing switch knob and taking out four small machine screws around center of switch. Do not lose the metal shim and felt washer located at the back of the switch plate. Make sure you can identify the original position of the switch so the echo and main will not be reversed when re-installed.

4. Remove front plate of rheostat box. Disconnect wires (Red, and shield) leading to preamplifier input. (Underneath metal cover on preamplifier).

5. Remove the preamplifier by taking out the four screws at the corners in the rubber cushions. Do not lose the metal spacers inside of the rubber cushions.

6. Take off swell pedal rod by taking off swell box cam pusher and removing screw on swell pedal crank shaft.

7. Take out the four screws holding rheostat box to the channel. ? It will be found that the rheostat box can conveniently be held in a horizontal position by wedging it between the top of the console and the drawbar sliders. Here it is out of the way and will not interfere with the proceedings.

8. Take out the channel by removing the four bolts holding it at the ends.

C. Removal of the Chorus Generator

9. Unsolder (do not cut) twenty-four wires from the chorus switch, counting from left to right. Now unsolder the remaining twelve wires, noting dual lug connections. (In resoldering these wires refer, if necessary, to Figure 6, Part 1B for guidance.)

10. Disconnect the ground strap between the main and chorus generators. This is located near the center, rear of the chorus switch.

11. At the power panel terminals, unsolder the wires to the chorus generator start and run motors.

12. Remove the four bolts and nuts that hold the terminal panel to the chorus generator frame.

13. The chorus generator can now be entirely removed.

D. Replacement of Playing Key

1. Open swell pedal and leave open during entire operation.

2. Remove the two cotter pins on the chorus drawbar action. These are located on the pivoted metal triangle on the left side of the manual chassis block.

3. Take out four screws from left and right hand side panels of music rack. Tilt bottom of rack by lifting the side panels, then pull outward.

4. If console is equipped with echo switch: Remove it by unscrewing the switch knob and taking out four small machine screws around center of switch. Do not lose the metal shim and felt washer located at the back of the switch plate. Make sure you can identify the original position of the switch so the echo and main will not be reversed when re-installed.

5. Remove the two wood screws and two hexagon head bolts from either end of the stop switch base.

6. The entire stop switch base can now be lifted up and blocked out of the way.

7. Lift the wooden bar (channeled underneath) which covers the hexagon head spring adjusting nuts at the rear of the keyboard.

8. Remove the hexagon nut and spring from the defective key.

9. Lift key off, back end first, pulling backward and upward.

D. Replacement of Playing Key

10. For lower manual key repair follow instructions up to and including number five. Then pull all drawbars out to position "8", tilt the upper manual as far as the top of the console will allow, then wedge or block in this position. Proceed then with instructions from number seven and complete.

11. Adjust tension of replaced key spring by comparison with the adjoining notes. You can, by carefully feeling the spring tensions at the end of the key, set the pressure closely enough for all practical purposes.

Note: This procedure applies to late Model A consoles, and all Model B, C, D and E instruments. To replace a playing key in Model A consoles numbered 2469 and below it is necessary to remove the manual chassis.

E. Replacement of the Starting Motor

1. To replace the starting motor on any main generator, follow the instruction under the heading, "Removal of the Main Generator". Early Model A consoles will require also the removal of the manual chassis. Follow instruction given under "Removal of manual chassis", as well as the generator removal procedure.

2. To replace the starting motor on any chorus generator, follow the instruction under the heading, "Removal of Chorus Generator". Exception to this is the Model E Chorus Generator. The start motor on this generator may be replaced without removing the generator.

3. When the generator is in the open, remove the oiling threads that lead from the oil trough to the two motor bearings. To accomplish this, lift up the copper cover of the oil trough and pull gently on the threads. It may be necessary to cut one or both of the threads if they do not readily pull out. When replacing the new threads be sure to put all of the thread possible underneath the white felt you will find in the trough.

4. You will observe that the starting motor is retained by two bolts which extend through the end of the generator frame. Remove the nuts and lock washers. Unsolder the two wires that lead from the motor to the power terminal panel. These are most easily disconnected at the motor itself, rather than to re-wire all the way to the terminal board.

5. The new motor may now be installed.

F. Replacement of Run Motor and Tremulant Assem.

1. Remove the wires leading to the motor at the power terminal panel. On consoles having both main and chorus generators, be sure the proper wires to the motor you intend to take out are selected.

2. Disconnect the shielded tremulant switch lead in the swell box. To accomplish this, remove the rheostat box cover. The proper lead is then easily determined by tracing the cable from the tremulant switch itself.

3. Remove the preamplifier as a unit by taking out the four machine screws at the corners in the rubber cushions. Do not lose the metal spacers inside the rubber cushions. Lay the preamplifier on its side.

4. On both main and chorus generators, the motor is attached to the generator frame by four machine screws which are a part of the motor assembly. Remove the nuts and lock washers and the entire assembly will come off by a gentle, backwards pull. You should carefully note, as it pulls away, the way in which the pins engage the generator main drive shaft.

Note

5. On some models, the chorus run motor has the front plate extended upward to provide additional support for the chorus generator gang switch. It is necessary, therefore, in this model, to remove two additional machine screws to free the motor.

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

Part 5

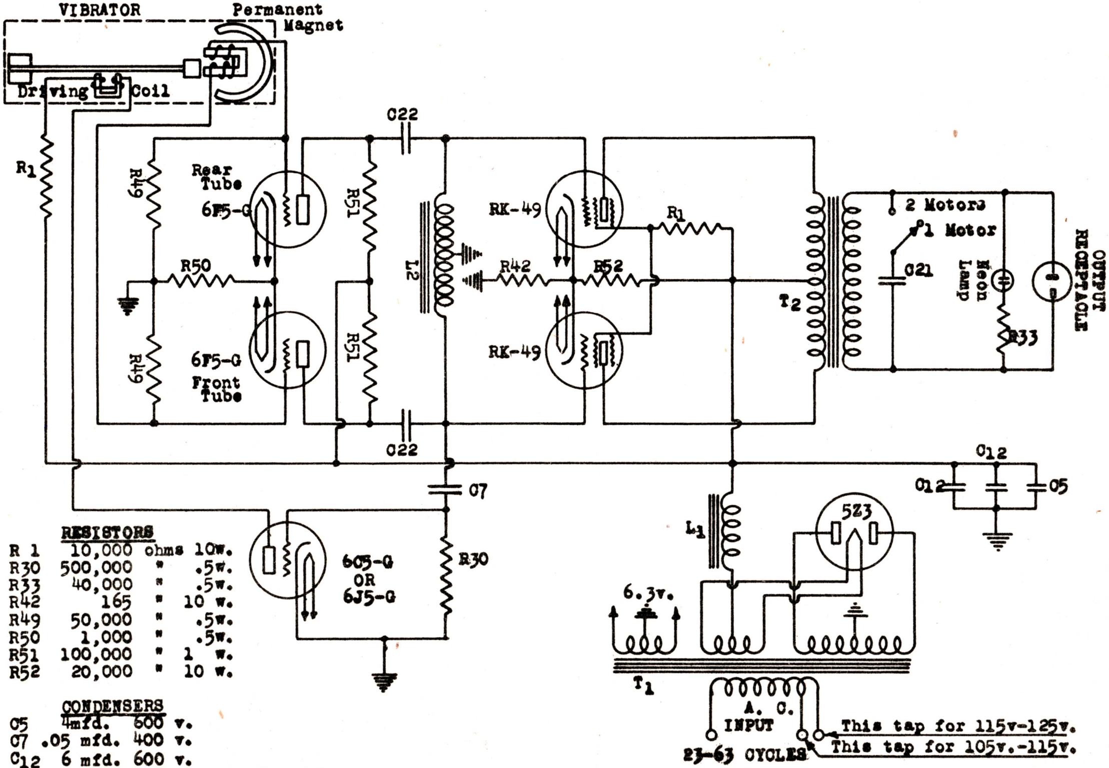
SPECIAL EQUIPMENT FOR THE HAMMOND ORGAN

A. The Tuning Fork Regulator

Hammond Instrument Co.
2915 N. Western Avenue
Chicago, Illinois

4/11/40 (Revised)

Printed in the United States of America


VIBRATOR
Permanent Magnet
Driving Coil
R1
R49
Rear Tube
6F5-G
R50
6F5-G
Front Tube
R51
R51
C22
C22
L2
RK-49
RK-49
R42
R52
R1
T2
2 Motors
1 Motor
C21
Neon Lamp
R33
OUTPUT RECEPTACLE
C12
C12
C5
C7
R30
6C5-G OR 6J5-G
L1
5Z3
6.3v.
T1
A. C. INPUT
23-63 CYCLES
This tap for 115v-125v.
This tap for 105v.-115v.

RESISTORS

R 1	10,000	ohms	10w.
R30	500,000	"	.5w.
R33	40,000	"	.5w.
R42	165	"	10 w.
R49	50,000	"	.5w.
R50	1,000	"	.5w.
R51	100,000	"	1 w.
R52	20,000	"	10 w.

CONDENSERS

C5	4mfd.	600 v.	
C7	.05 mfd.	400 v.	
C_{12}	6 mfd.	600 v.	
C21	10 mfd.	115 v.	3.5 mfd. 230v.
C22	.1 mfd.	600 v.	

A.C. FREQUENCY REGULATOR- MODEL G.
FIGURE 1.

T1	Power transformer
T2	Output transformer

L1	Choke coil	RE-3108
L2	Choke coil	500 henries min.inductance. 2500 ohms max.D.C. Resistance.

The Tuning Fork Regulator

The Hammond organ is furnished in several models designed to operate from a closely regulated 25, 50 or 60 cycle current source. The tone generators are driven by synchronous motors and any variations in frequency will vary the speed of the motors and thus the pitch of the instrument. For example, a frequency variation in 60 cycle current of ½ cycle is noticeable in the output of the organ, and a variation of as much as 1½ cycles is definitely objectionable.

The tuning fork regulator is a device of our manufacture which is designed to furnish sufficient closely regulated current of proper frequency to operate the organ from unregulated AC or converter AC as produced by a DC to AC rotary converter.

Start motors, preamplifier and power amplifiers are not critical to slight frequency variations, so when the frequency regulator is used it is connected to furnish regulated current only to the synchronous run motors.

Model G Regulator

The Model G regulator is designed for AC operation only, and may be energized by any 23 to 63 cycle line. Current consumption is approximately 125 watts. This must be taken into consideration when the organ is to be operated from the output of a DC to AC converter. Failure to provide a converter of adequate size may result in low line voltage and impaired operation of the instrument.

Circuit

Figure 1 shows a circuit diagram of the regulator. A straight vibrating arm is used, with push-pull pick up coils and a permanent magnet. The signal is passed through a push-pull resistance coupled circuit consisting of two 6F5-G tubes and then into two RK-49 output tubes.

R-42 and R-52 furnish grid bias to the tubes, while R1 provides proper screen voltage for the output tubes. Oscillation is maintained by a driving coil fed through a 6C5-G or a 6J5-G tube. (These tubes are interchangeable).

A small neon glow lamp across the output indicates proper operation of the regulator. Resistor R-33 protects the neon lamp in regulators having 230 volt output. The output switch connects a power-factor correcting condenser in order to obtain maximum output when two running motors are to be supplied. The power supply circuit employs a full wave rectifier with a single choke filter and an oil condenser block.

The 115 and 230 volt models differ in the power transformer and output transformer used. Power transformers for both voltages have marked taps to compensate for slight line voltage variation. Models for 50 and 60 cycle output differ only in the vibrating reed.

Tubes used: 1 5Z3, 2 RK-49, 2 6F5-G, and 1 6C5-G or 6J5-G.

NOTE: Model G Regulators of 115 volt - 60 cycle output serial numbered below 1101, 115 volt - 50 cycle below 1060, and 230 volt - 50 cycles below 2059 used two 6L6-G tubes instead of RK-49's. Also choke L1 and resistor R1 were not used.and R52 was 20,000 ohms.

Adjustment of Pitch

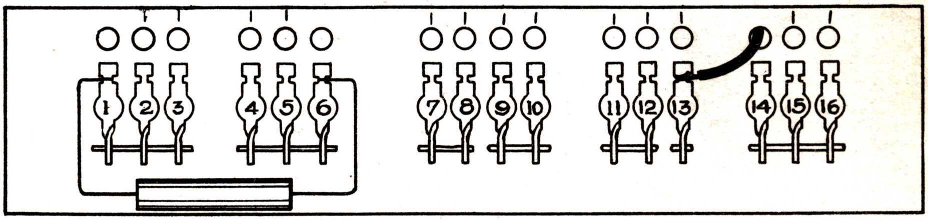
Adjustment of pitch is possible by moving a weight on the vibrating arm. A single weight is provided for this purpose. Moving this weight toward the center of the arm raises the pitch, and moving it toward the end will lower the pitch. The range of the pitch adjustment is approximately 430 to 450 for middle **A** (normally 440). This pitch may be checked by means of a 60 cycle synchronous clock, which is connected to the regulator receptacle and compared with any other accurate timepiece.

If the electric clock checks exactly, the organ pitch will be A 440. A difference of two seconds in an interval of 14 minutes and 40 seconds will change the pitch one part in 440. For example, if the synchronous clock indicates 14 minutes and 48 seconds in an actual interval of 14 minutes and 40 seconds, the organ pitch will be 444 for middle **A**.

IMPORTANT

Installation

In order to use the Model G regulator with an organ, a change in the wiring on the power panel inside the console is necessary. This change in power wiring is shown in figure 2.



VIEW OF LINE PANEL AFTER CHANGES ARE MADE
FIGURE 2.

These changes are made as follows:
  1-Move blue wire from 14 to 13. (Do not make any other changes in 13)
  2-Cut out jumper between 8 and 9.
  3-Cut out jumper between 12 and 13.

If serial number of Console is below No. 328 it will be necessary to interchange wires 8 and 9 in order to make revamped panel connections check with diagram shown above. If serial number is below No. 775 it may also be necessary to interchange wires 12 and 13.

In addition to above changes, one of the power circuits shown in figures 3 and 4 should be used. Also, the console-to-cabinet cable must be spliced to separate the power cord as shown in figure 5.

Figure 3 shows a typical installation of the Model G regulator for use on an unregulated frequency A.C. line.
Figure 4 shows a typical installation where the unregulated A.C. is supplied by a rotary converter.
In both of these figures, the switch #2 is provided to eliminate undesirable noise which is introduced through the amplification system if the console is started after the amplifiers have been turned on. Switches #1 and #2 should both be located near the console.

To start the organ when installed in this manner, the following procedure should be followed:

1. Turn on switch #1. Watch for the neon lamp on the regulator to glow.

2. Start the console in the usual manner.

3. Turn on switch #2.

A maximum of three amplifiers may be energized through the console to cabinet cable as shown. If additional cabinets are required they should be connected in the usual manner to a separate power source.

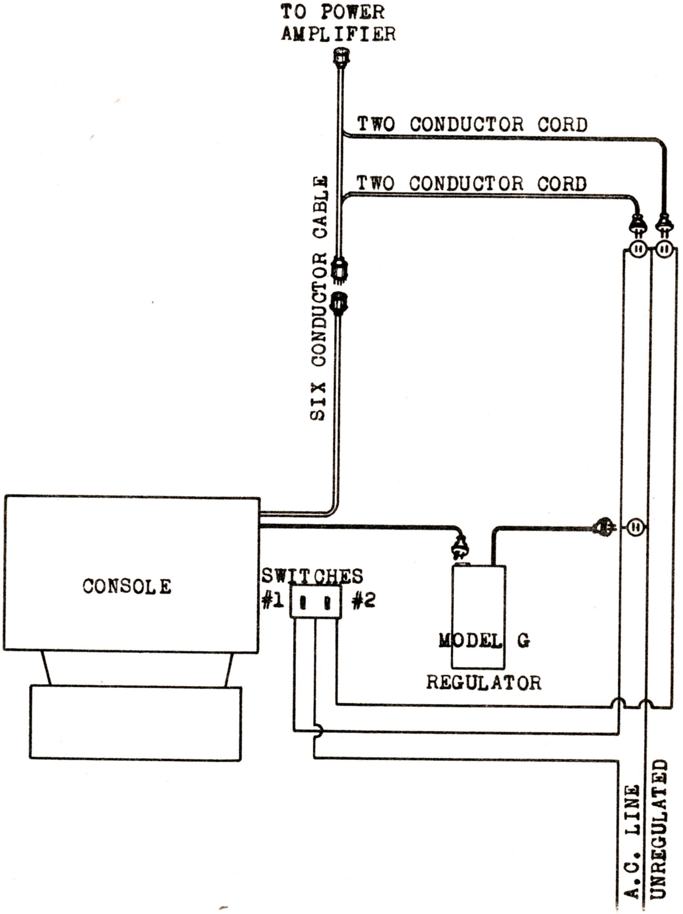
Switch #2 may be eliminated by including a special relay in series with the synchronous motors to turn on the power cabinets.
Figure 7 shows this relay in use. This relay does not have sufficient current carrying capacity to control the A.C. supply to the power amplifiers directly, therefore, it is necessary to also include a type A-107 relay for this purpose.

Type 3040A5 relay manufactured by the Automatic Electric Company is used in series with the console run motors, and type A-107 manufactured by the Allen-Bradley Company is used to energize the power amplifiers. Both of these relays may be ordered from the Hammond Instrument Company at a net price of $4.50 each, or they may be ordered direct from the manufacturers.

A convenient method of providing automatic operation is to mount both relays in a box provided with the necessary fittings to connect to organ equipment and power source as shown in figure 6. This method is especially useful for demonstration work as no special wiring is necessary other than the usual changes to console line panel shown in figure 2.

Such a "relay box" may be located in any location most convenient for plugging in the organ equipment. A box 18 inches by 8 inches outside dimensions is a convenient size as the Model G regulator may then be placed on top of the relay box and the connections made in an orderly manner. The relay box should be at least 3½" in depth inside.

These boxes are not available from the factory, but may be easily made and wired by the service man.


TO POWER AMPLIFIER
TWO CONDUCTOR CORD
TWO CONDUCTOR CORD
SIX CONDUCTOR CABLE
CONSOLE
SWITCHES
#1
#2
MODEL G
REGULATOR
A.C. LINE
UNREGULATED

? why two

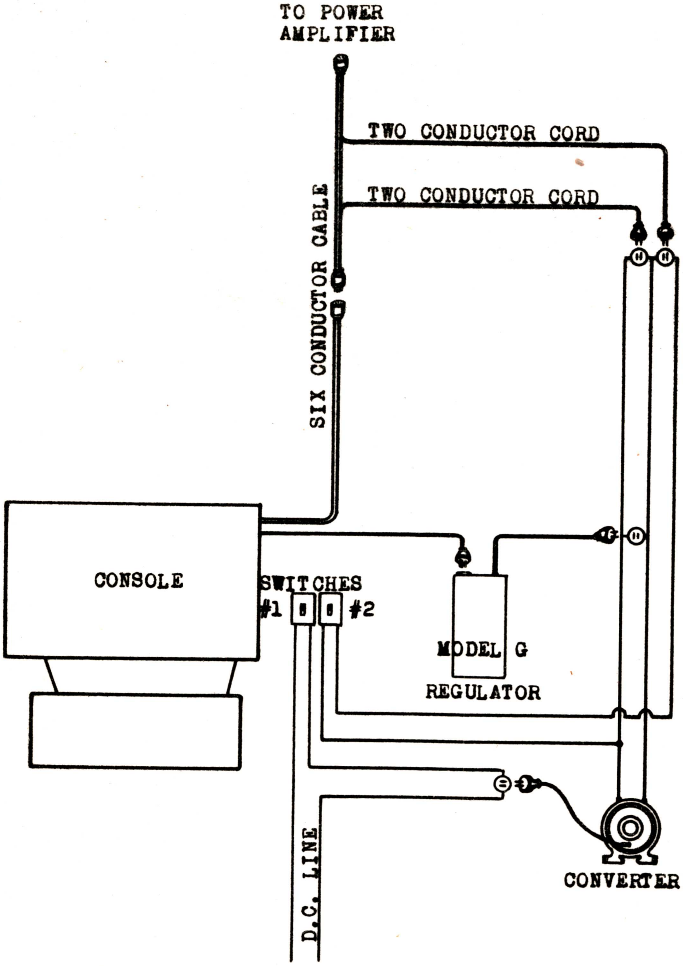
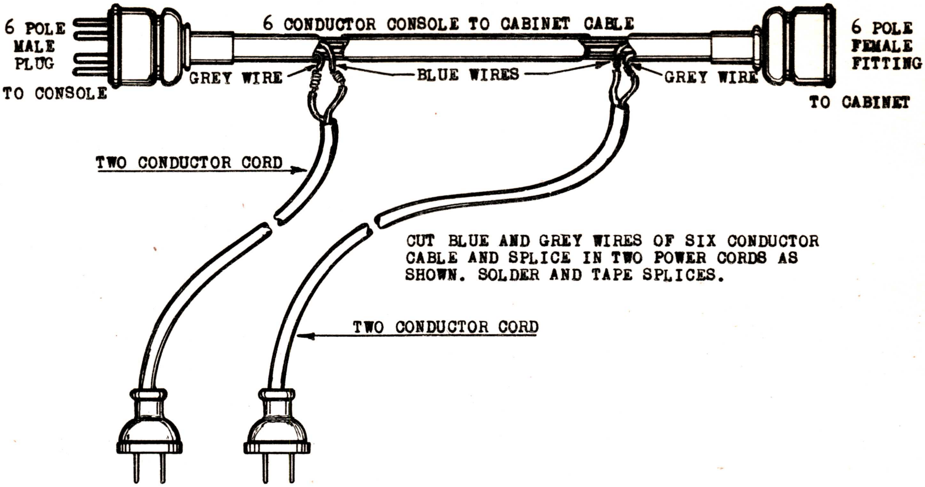
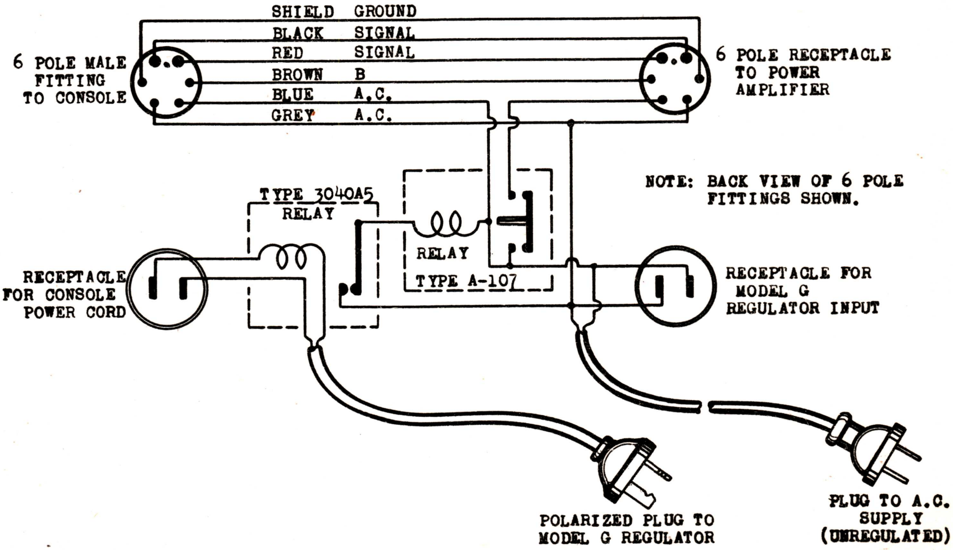

TO POWER
AMPLIFIER
TWO CONDUCTOR CORD
TWO CONDUCTOR CORD
SIX CONDUCTOR CABLE
CONSOLE
SWITCHES
#1
#2
MODEL G
REGULATOR
CONVERTER
D.C. LINE

FIGURE 4.


6 POLE MALE PLUG
TO CONSOLE
6 CONDUCTOR CONSOLE TO CABINET CABLE
6 POLE FEMALE FITTING
TO CABINET
GREY WIRE
BLUE WIRES
GREY WIRE
TWO CONDUCTOR CORD
TWO CONDUCTOR CORD

CUT BLUE AND GREY WIRES OF SIX CONDUCTOR CABLE AND SPLICE IN TWO POWER CORDS AS SHOWN. SOLDER AND TAPE SPLICES.

FIGURE 5.


SHIELD GROUND
BLACK SIGNAL
RED SIGNAL
BROWN B
BLUE A.C.
GREY A.C.
6 POLE MALE FITTING TO CONSOLE
6 POLE RECEPTACLE TO POWER AMPLIFIER
TYPE 3040A5 RELAY
RELAY TYPE A-107
RECEPTACLE FOR CONSOLE POWER CORD
RECEPTACLE FOR MODEL G REGULATOR INPUT
POLARIZED PLUG TO MODEL G REGULATOR
PLUG TO A.C. SUPPLY (UNREGULATED)

NOTE: BACK VIEW OF 6 POLE FITTINGS SHOWN.

FIGURE 6.

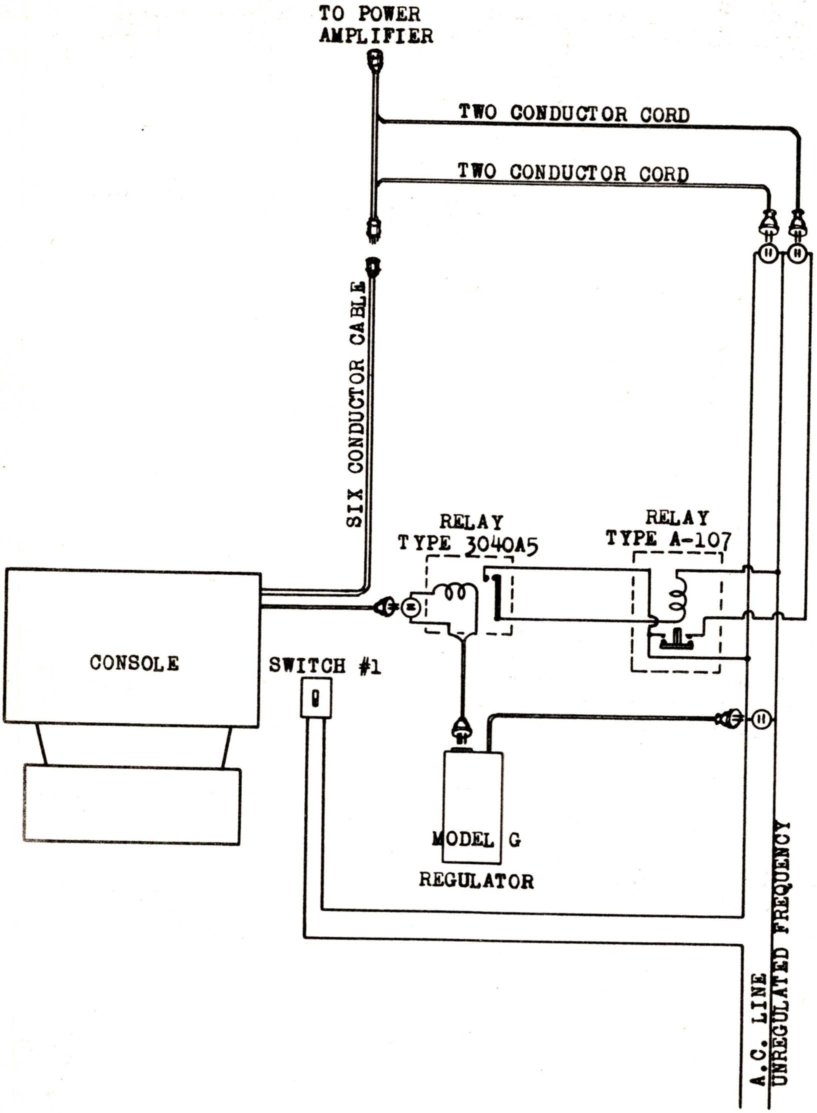

TO POWER AMPLIFIER
TWO CONDUCTOR CORD
TWO CONDUCTOR CORD
SIX CONDUCTOR CABLE
RELAY TYPE 3040A5
RELAY TYPE A-107
CONSOLE
SWITCH #1
MODEL G REGULATOR
A.C. LINE
UNREGULATED FREQUENCY

FIGURE 7.

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 5

SPECIAL EQUIPMENT FOR THE HAMMOND ORGAN

B - Echo Switch Installation
in the Model B Console.

HAMMOND INSTRUMENT COMPANY,
2915 N. Western Avenue,
Chicago, Illinois

Revised 2.5.42

ECHO SWITCH INSTALLATION IN MODEL B CONSOLE
(Also Applies To Model A)

The echo switch available for the Model B console provides three optional positions. When the switch is set to the left the main organ sounds, and to the right the echo organ sounds. If set in the center or neutral positions both organs sound simultaneously.

The echo switch kit as listed in the standard price sheet includes all necessary installation material. To install the switch proceed as follows:

1. Disconnect the chorus drawbar from the lever inside of console by removing coupling pin, then remove the four screws in the end blocks and remove the entire music rack assembly from console.

2. Drill holes in music rack panel assembly for echo switch. See Figure 1 for exact dimensions and location. The music rack should then be replaced and the echo switch mounted.

3. Disconnect swell cam actuator and remove screws holding rheostat box in place. Remove cables from clip but do not unsolder wires.

4. Remove line panel cover and disconnect line cord. Remove pre-amplifier terminal cover, disconnect 6 conductor cable and pre-amplifier mounting screws.

5. Unfasten mounting channel, disconnect and remove swell pedal connecting rod and remove screws from pedal switch cover panel.

6. Remove key holding right hand wiring tube, raise tube about six inches and lift pedal switch cover out of way.

7. Unfasten cable terminal box from console, loosen cable clips and withdraw line cord and 6 conductor cable from wiring tube.

    Note: For consoles not equipped with outlet box,attach a standard cap and cord grip to receptacle of short cable assembly furnished with the echo switch kit,insert through console cable hole and proceed according to directions #9 to #11 below. The cable receptacle will be extended about six inches in this case. If cable connector fittings at console are undesirable a standard 5 conductor of any desired length may be prepared with terminal lugs at console end and installed in same manner.

8. Open terminal box,knock out receptacle hole blank nearest right hand end,mount 5 pole receptacle and cable and reassemble and attach terminal box to console.

9. Pull the two cables and line cord through wiring tube simultaneously. Mount cable clip (See item 6, Figure 1) and insert 5 conductor cable. Replace pedal switch cover, wiring tube and mounting channel.

10. Connect cables and wire echo switch as shown in Figure 1 and replace pre-amplifier, rheostat box and swell pedal mechanism. Also replace line panel cover, fastening wiring panel as shown.

11. Check for proper operation. If echo organ sounds when switch is in "main" position and main organ sounds with switch in "echo" position, interchange the two red wires, and interchange the two black wires at the echo switch wire panel.

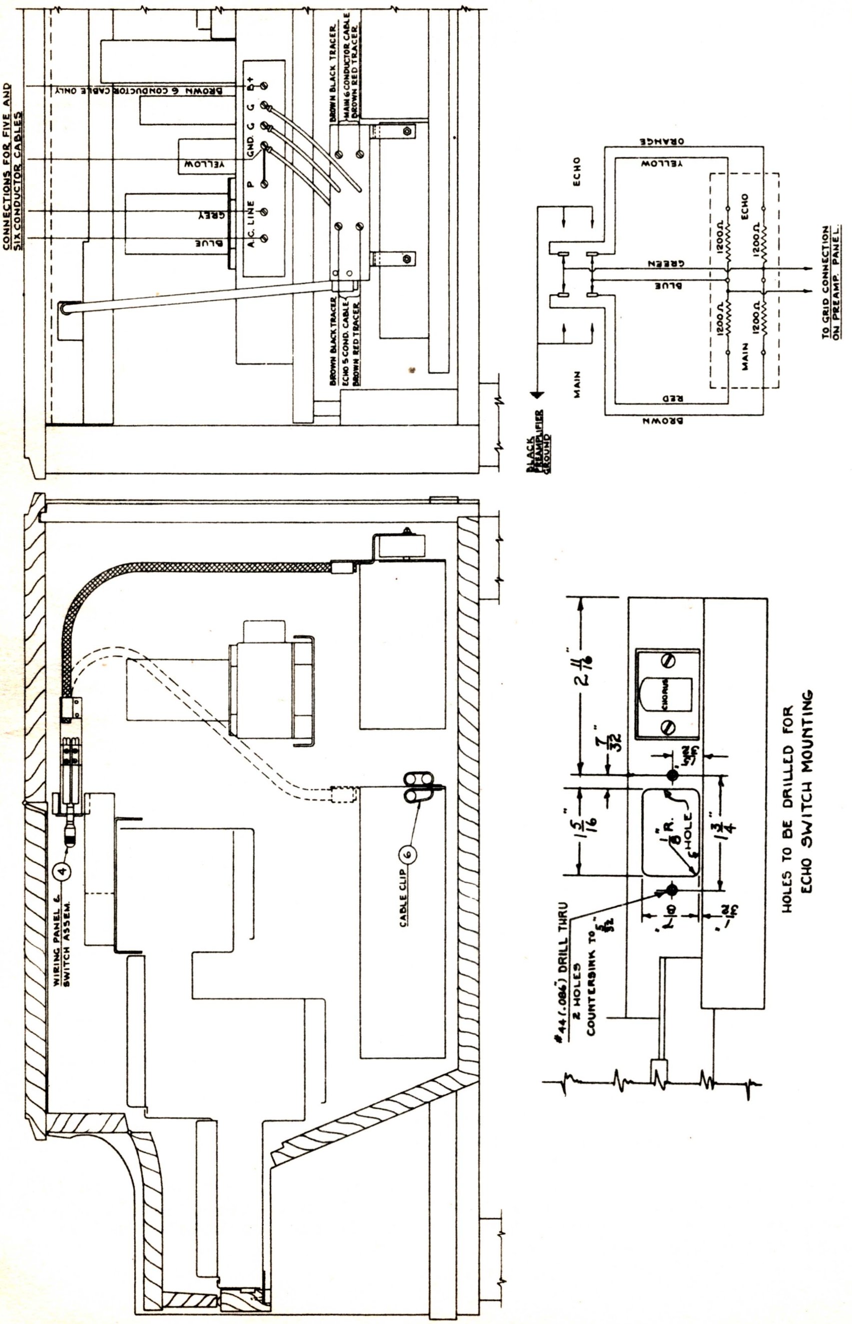

CONNECTIONS FOR FIVE AND SIX CONDUCTOR CABLES
BROWN 6 CONDUCTOR CABLE ONLY
YELLOW
GREY
BLUE
A.C. LINE
P
GND.
G
G
B+
BROWN BLACK TRACER
MAIN 6 CONDUCTOR CABLE
BROWN RED TRACER
BROWN BLACK TRACER
ECHO 5 COND. CABLE
BROWN RED TRACER
ECHO
MAIN
BLACK PREAMPLIFIER GROUND
ORANGE
YELLOW
GREEN
BLUE
RED
BROWN
1200Ω
1200Ω
1200Ω
1200Ω
ECHO
MAIN
TO GRID CONNECTION ON PREAMP. PANEL.
WIRING PANEL & SWITCH ASSEM.
4
CABLE CLIP
6
#44 (.086") DRILL THRU
2 HOLES
COUNTERSINK TO 5/32"
2 11/16"
7/32"
1 5/16"
1 3/4"
1/8" R.
HOLE
CHORUS
HOLES TO BE DRILLED FOR ECHO SWITCH MOUNTING

FIGURE I

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 5

SPECIAL EQUIPMENT FOR THE HAMMOND ORGAN

C - Echo Switch Installation in the Model E Console.

Hammond Instrument Company
2915 North Western Avenue
Chicago, Illinois

5.20.38

Printed in the United States of America

ECHO SWITCH INSTALLATION IN THE MODEL E CONSOLE

The echo switch provided for installation in the Model E console is identical in operation with the switch used for the Model B console. When the switch is set to the left the main organ sounds, and to the right the echo organ sounds. If switch is left in the center in a neutral position all cabinets sound simultaneously.

The echo switch kit as listed in the standard price sheet includes all material necessary to make the installation. Follow the steps below to install the switch.

1. Remove the blank escutcheon plate on right side of console beside the chorus control, then install switch by passing it up through the hole in the shelf. Be sure to mount switch so main organ sounds on left position and echo on the right.

2. Mount terminal strip to shelf under preamplifier. Studs are provided for this purpose. Screws will be found in bag with the switch.

3. Remove terminal box and knock out socket hole blank on upper part of box and cable hole blank on bottom of the terminal box.

4. Insert socket and cable through socket hole, then clip the socket permanently in place.

5. Mount terminal box again on side of console.

6. Remove preamplifier terminal cover and disconnect red and black rubber covered wires (signal or grid) from terminal strip.

7. Connect green and blue wires from echo terminal strip to grid or signal terminals, blue on the left terminal and green on the right terminal, facing console from the rear. The black wire should be connected from terminal strip to ground terminal.

8. Connect the blue and grey wires (A.C.) from echo cable to A.C. terminal connections on the preamplifier. Connect yellow wire in echo cable to the preamplifier ground terminal.

9. Replace terminal strip cover.

10. Connect red and black wires (grid or signal) from six conductor cable to right hand terminals, black on top and red on the bottom. Connect red and black wires (grid or signal) from five conductor cable to left hand terminals, black on top and red on the bottom.

Note: See figure 1 on next page for illustration of wiring detail.

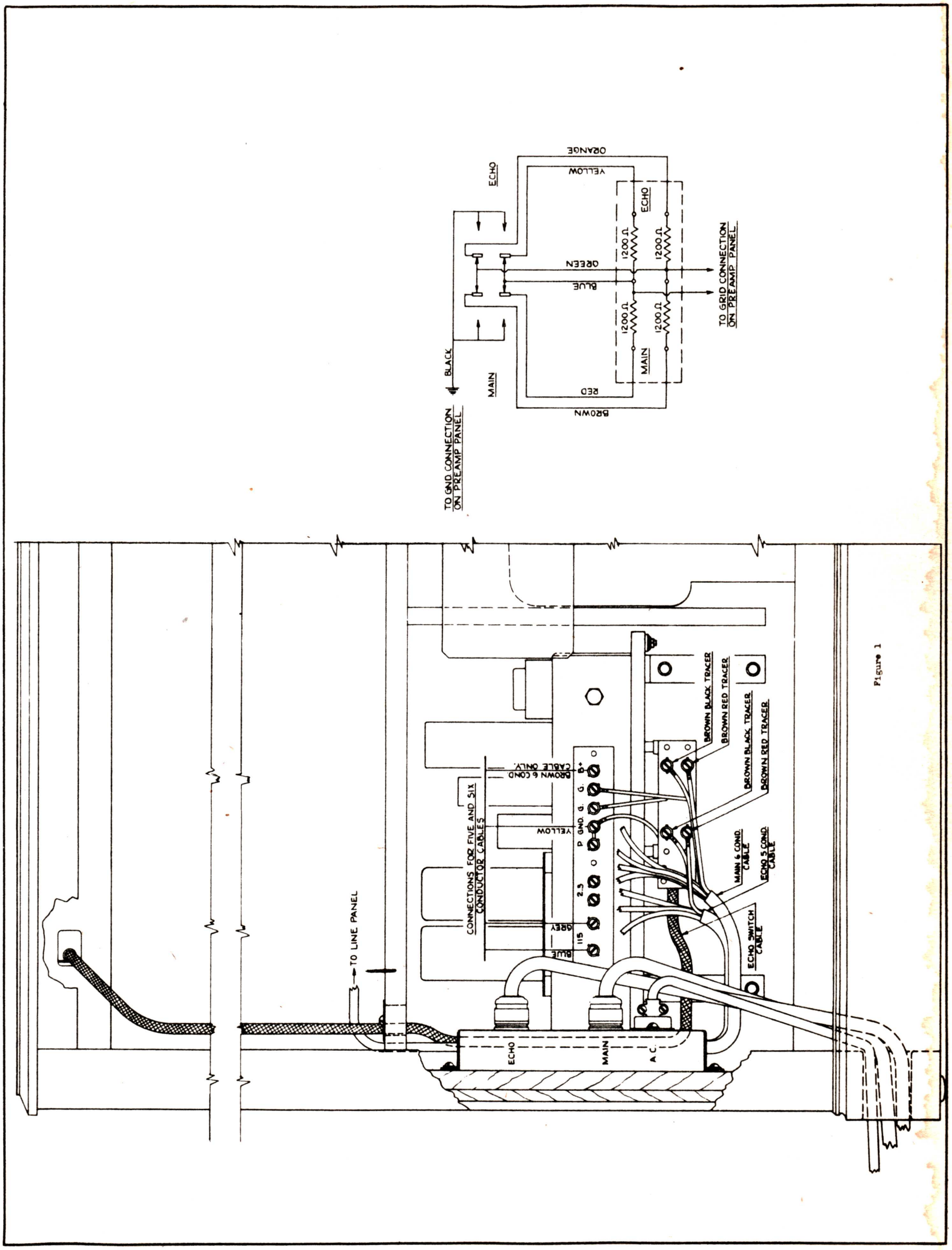

TO GND CONNECTION ON PREAMP PANEL
BLACK
MAIN
ECHO
BROWN
RED
ORANGE
YELLOW
GREEN
BLUE
1200 Ω
1200 Ω
1200 Ω
1200 Ω
MAIN
ECHO
TO GRID CONNECTION ON PREAMP PANEL
TO LINE PANEL
CONNECTIONS FOR FIVE AND SIX CONDUCTOR CABLES
BLUE
GREY
YELLOW
BROWN 6 COND CABLE ONLY.
115
2.5
P
GND.
G.
G.
B+
BROWN BLACK TRACER
BROWN RED TRACER
BROWN BLACK TRACER
BROWN RED TRACER
MAIN 6 COND. CABLE
ECHO 5 COND. CABLE
ECHO SWITCH CABLE
ECHO
MAIN
A.C.

Figure 1

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 5

SPECIAL EQUIPMENT FOR THE HAMMOND ORGAN

D. Connections for using earphones with the organ.

HAMMOND INSTRUMENT COMPANY
2915 North Western Avenue
Chicago, Illinois

9/12/41

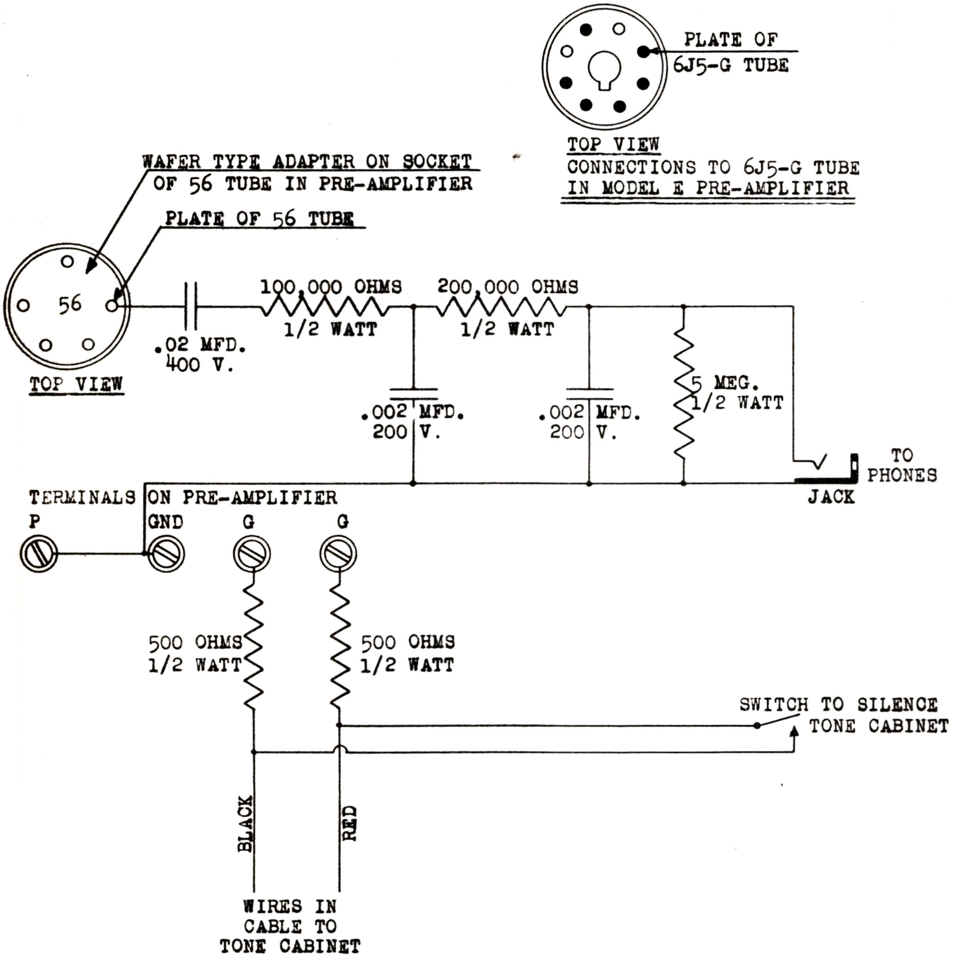


PLATE OF
6J5-G TUBE
TOP VIEW
CONNECTIONS TO 6J5-G TUBE
IN MODEL E PRE-AMPLIFIER
WAFER TYPE ADAPTER ON SOCKET
OF 56 TUBE IN PRE-AMPLIFIER
PLATE OF 56 TUBE
56
TOP VIEW
.02 MFD.
400 V.
100,000 OHMS
1/2 WATT
200,000 OHMS
1/2 WATT
.002 MFD.
200 V.
.002 MFD.
200 V.
5 MEG.
1/2 WATT
TO
PHONES
JACK
TERMINALS ON PRE-AMPLIFIER
P
GND
G
G
500 OHMS
1/2 WATT
500 OHMS
1/2 WATT
SWITCH TO SILENCE
TONE CABINET
BLACK
RED
WIRES IN
CABLE TO
TONE CABINET

EAR PHONE CONNECTIONS TO PRE-AMPLIFIER

FIGURE 1.

CONNECTIONS FOR USING EAR PHONES WITH THE ORGAN

Ear phones may be connected to any Hammond Organ console. Organists often find it convenient to use them while practicing, and they are particularly useful in homes and apartments where the use of a tone cabinet is likely to disturb others.

The equipment necessary for attaching the phones is listed below and the proper connections are shown in Figure 1. Resistor and condenser values should be exactly as given. Substitutions may impair the musical quality of the results.

The phones should be of the crystal type. The frequency response range of the usual magnetic type phones is not adequate for best results when used with the organ. The circuit shown is especially designed for use with crystal phones and might not be suitable for use with other type phones. If your local radio dealer cannot supply the proper type phones, write to the Organ Service Department, Hammond Instrument Company, for information regarding where they may be purchased.

Parts Required

1 pair crystal phones
1 phone jack
1 100,000 ohm resistor)
1 200,000 " ") 1/2 watt
1 5 megohm ")
* 2 500 ohm resistors)

2 .002 mfd condenser --- 200 volt
1 .02 mfd condenser --- 400 volt
1 wafer type adapter for 56 or 6J5-G tube
* 1 small single pole toggle switch

* Parts marked with an asterisk are for the purpose of silencing tone cabinet while phones are in use.

Installation

1. Mount phone jack on console.
2. Connect phone circuit resistors, condensers and adapter as shown.
3. Insert adapter under 56 tube in pre-amplifier (for models A, B, C, D or Player consoles) or under 6J5-G tube (for model E consoles).
4. Connect leads to GND post on pre-amplifier and to jack as shown.

To connect resistors and switch for silencing tone cabinet, proceed as follows:
1. Cut black and red signal leads of console to cabinet cable about 1-1/2 inches from where they enter cable sheath, then insert the 500 ohm resistors in the circuit and make connections to switch as shown in Figure 1.
2. Solder and tape connections neatly so that resistor leads are not exposed and thereby subject to accidental short circuit.

All parts listed above are standard radio items and may be purchased from your local radio dealer. They are not available from Hammond Instrument Company.

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 5

SPECIAL EQUIPMENT FOR THE HAMMOND ORGAN

E. Installation instructions for foot switch. CX-20, CXR-20, DX-20 and DXR-20 cabinets.

HAMMOND INSTRUMENT COMPANY
2915 N. Western Avenue
Chicago, Illinois

3/20/41 Revised

Printed in the United States of America

INSTALLATION INSTRUCTIONS FOR FOOT SWITCH CX-20, CXR-20, DX-20 & DXR-20 CABINETS

The foot switch kit contains all necessary parts to permanently install a remote control switch at the console to turn the rotating cylinder in the X type cabinet on or off at will.

Full instructions for installing a single foot switch on the B, D, E and Player are given below. Occasionally it may be desirable to use two of these switches to control two rotor tremulants separately. It will be found, however, that only one knock out is provided in the D, E and Player outlet boxes for this purpose. In such instances it is suggested that a receptacle shell be ordered from the factory. This shell can be fitted with the four pole male plug furnished with the kit and mounted beside the outlet box.

1. Proceed as follows to make switch installation on Model B console.

    a. Remove pedal switch cover board by taking out four wood screws and disconnecting the swell pedal rod. Cover board may be raised by lifting it slightly, then pulling it forward.

    b. Drill three holes in cover board, one 3/8", one 3/16" and one 7/64". See Figure 1 for location of all holes. Note that drawing gives two sets of holes in case two switches are desired.

    c. Next run free end of two conductor cable through hole in console where other cables enter, then through 3/8" hole in cover board. Attach cable clamp provided to under side of cover board.

    d. Now attach the two conductor cable to the switch and mount, then replace pedal switch cover board in normal position. Attach swell pedal connecting rod.

    e. The cable is now ready to be connected for operation. If a single X type cabinet is to be used, simply remove the back panel, plug the two pole female plug into the male receptacle in the bottom of the cabinet and plug the five pole male plug into the free amplifier receptacle.

    Figure 3 illustrates wiring inside tone cabinet when no foot switch is used. Figure 4 shows similar wiring using a foot switch.

    f. The short two conductor coupling cable furnished with X type cabinet is not used with remote control switch installation.

Reverberation Cont

Reverberation Controls
To X Cabinets

g. Should it be desired to operate two or three X type cabinets from a single console switch a special coupling cable will be required. This cable is identified as AO-16004 and is equipped with a two pole female plug on one end and a special male and female fitting on the other end.

This cable is used for interconnecting #1 and #2 cabinets and for #2 and #3. The two pole female plug is attached to the receptacle in the bottom of the #1 or #2 cabinet and the special fitting goes to the same receptacle in the last X type cabinet.

In this manner the 6 conductor console-to-cabinet cable runs to the #1 cabinet, while the 2 conductor remote control switch cable runs from the console to the last X type cabinet. With this arrangement the 5 conductor cabinet-to-cabinet cables may be connected in the usual manner. The 5 pole male plug attached to the remote control cable may then be plugged into the extra receptacle in the last amplifier.

Figure 5 shows wiring between cabinets when two X type cabinets are used with a single console. Figure 6 shows wiring between multiple cabinet installations when more than three amplifiers are used and thus an external AC source must be used.

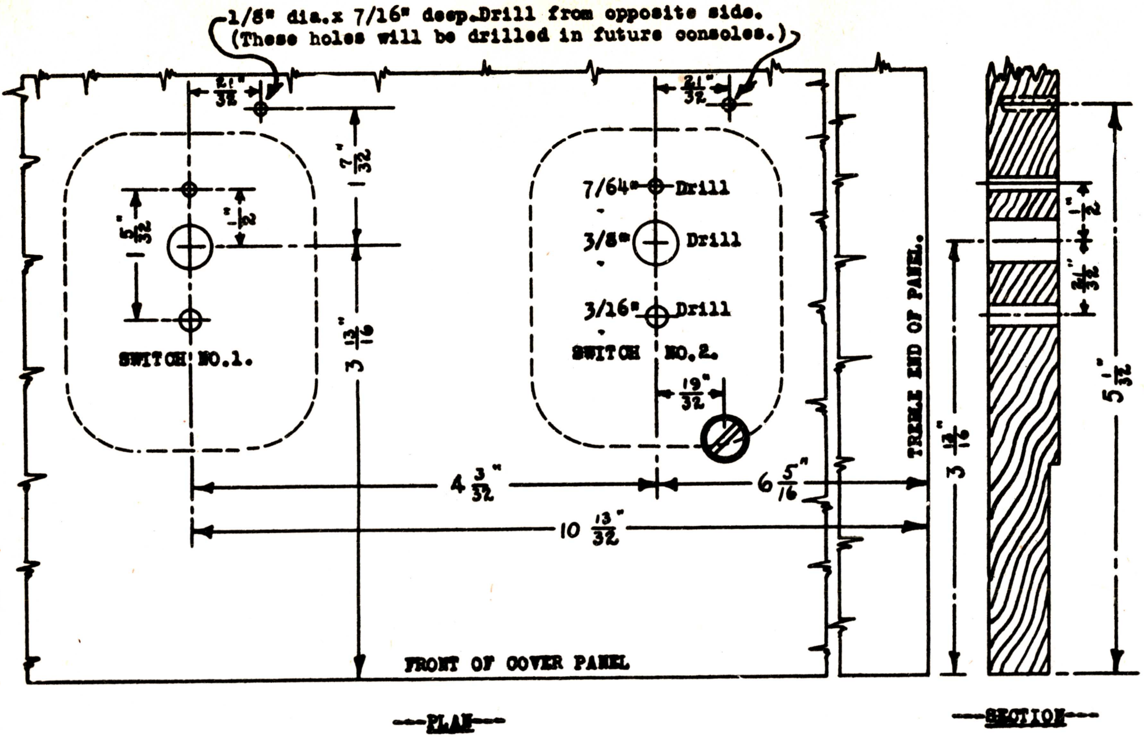
2. Proceed as follows to make switch installation in Model E console.

a. Drill front panel as shown in Figure 2. Drill only one set of holes unless two switches are to be installed.

b. Take the two conductor cable included with the kit and cut off a piece 36" long from the free end. Solder the wires at one end of this piece to the two larger poles of the four pole male fitting also included with the kit, and mount this fitting in the outlet box by removing the large socket hole knockout nearest the center of the box, and clipping the fitting permanently in place.

NOTE: If the outlet box is of the earlier type having 9/16" knockout and there is no socket hole knockout available, it will be necessary to use the two pole male fitting instead of the four pole fitting just mentioned. Remove the 9/16" knockout and mount this fitting on the face of the box. Run wires through knockout hole and connect to fitting. CAUTION: WHEN CONNECTING CONSOLE TO POWER SOURCE MAKE SURE THAT THIS FITTING IS NOT PLUGGED INTO POWER CORD.

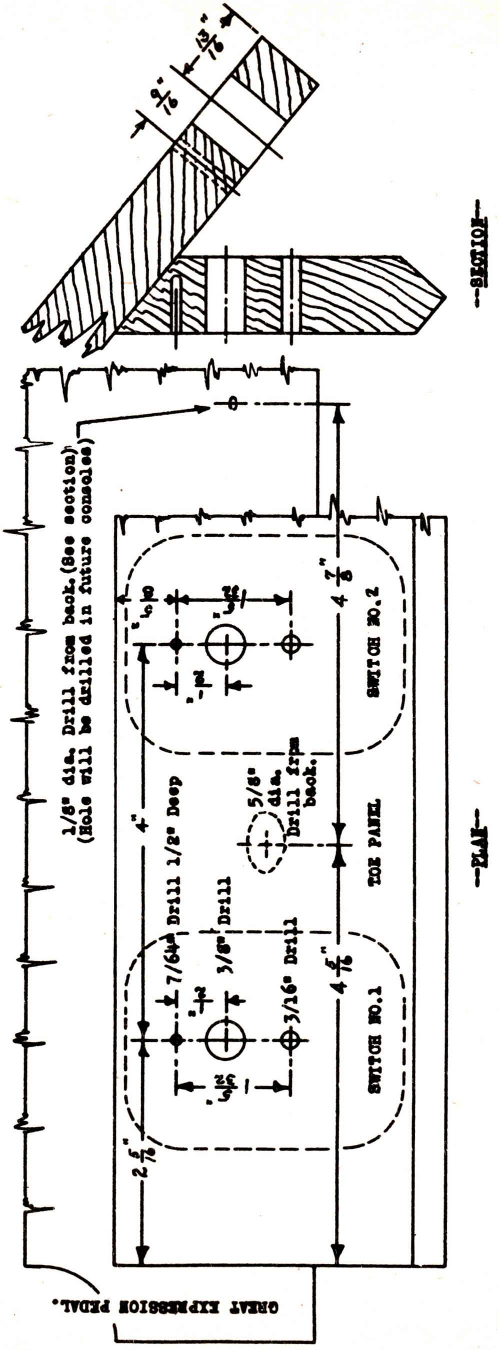
c. The switch is now ready to mount, but first it is necessary to change the switch setting because the mercury switch element is assembled at the factory for operation in a horizontal position as on a Model B Console.


1/8" dia.x 7/16" deep.Drill from opposite side.
(These holes will be drilled in future consoles.)
21/32"
21/32"
7/32"
1 7/32"
5/32"
1 5/32"
1/2"
7/64" Drill
3/8" Drill
3/16" Drill
SWITCH NO.1.
SWITCH NO.2.
3 13/16"
19/32"
4 3/32"
6 5/16"
10 13/32"
FRONT OF COVER PANEL
TREBLE END OF PANEL.
3 13/16"
5 1/32"
---PLAN---
---SECTION---

COVER PANEL DRILLING FOR FOOT SWITCHES.

CONSOLE MODELS A, B, C, D, AND AEOLIAN-HAMMOND PLAYER CONSOLES

FIGURE 1.


9/16"
13/16"
--SECTION--
1/8" dia. Drill from back. (See section)
(Hole will be drilled in future consoles)
5/8"
1 3/32"
1/2"
4"
7/64" Drill 1/2" Deep
3/8" Drill
3/16" Drill
5/8" dia. Drill from back.
2 5/16"
4 5/16"
4 7/8"
SWITCH NO.1
SWITCH NO.2
TOE PANEL
GREAT EXPRESSION PEDAL.
--PLAN--

CONSOLE DRILLING FOR FOOT SWITCHES.

MODEL E CONSOLE.

FIGURE 2.

To make this change take the switch apart by removing the bakelite housing, then push the switch as far as it will go to the "on" position. Next take out the two brass stop screws, one on either side, then move the switch again in the same direction to the second set of screw holes.

Now replace the screws, connect the free end of the 36" cable to the switch, assemble the housing, and mount the switch. The cable clamp should be attached on the inside of the front panel near the point where the cable passes through to the switch.

d. Attach the proper female fitting furnished with the kit to the free end of the remaining cable, then plug it into the fitting just installed in the outlet box. The cable is now ready for connection to the X type cabinet. Proceed as outlined under "e" to "g" of Model B Instructions.

3. Proceed as follows to make switch installation in Player Console.

a. Remove pedal switch cover board by taking out wood screws and disconnecting swell pedal connecting rod.

b. Drill holes in pedal switch cover board as shown in Figure 1. Note that two sets of holes are shown; one set only is necessary for a single switch.

c. Next cut a 36" length of two conductor cable from free end of cable provided with the kit. Run this cable through cover board, attach to foot switch, and mount the switch.

d. Unfasten the outlet box from the console and mount the four pole male fitting by removing the large socket hole knockout nearest the center of the box and clipping fitting permanently in place.

NOTE: If the outlet box is of the earlier type having 9/16" knockout and there is no socket hole knockout available, it will be necessary to use the two pole male fitting instead of the four pole fitting just mentioned. Remove the 9/16" knockout and mount this fitting on the face of the box. Run wires through knockout hole and connect to fitting. CAUTION: WHEN CONNECTING CONSOLE TO POWER SOURCE MAKE SURE THAT THIS FITTING IS NOT PLUGGED INTO POWER CORD.

e. Run the cable from the switch through the hole in end of outlet box and solder the wires to the two larger poles of the four pole fitting. The outlet box may now be replaced.

f. Attach the proper female fitting furnished with the kit to the free end of the remaining cable, then plug it into the fitting just installed in the outlet box. The cable is now ready for connection to the X type cabinet. Proceed as outlined under "e" to "g" of Model B Instructions.

4. To install foot switch on Model C & D Consoles, proceed as follows:

   a. Drill the three holes in pedal switch cover board as shown in Figure 1. Note that two sets of holes are shown: one set only is necessary for a single foot switch.

   b. Unfasten pedal switch cover board by taking out four screws from top of board and also disconnecting swell pedal connecting rod, The cover board may then be raised by lifting slightly and pulling forward.

   c. Take the two conductor cable included in the kit and cut off a piece 28 inches in length from the free end. Connect this piece to the foot switch and mount the switch on cover board.

   d. Clamp the cable to the underside of cover board. A hole for clamp attaching screw is provided near switch location as shown in Figure 1.

   e. Remove all chips from pedal switch assembly and replace cover board and swell pedal connecting rod.

   f. Unfasten the outlet box from inside base of console and mount the four pole male fitting by removing socket hole knockout nearest center of box and clipping fitting permanently in place.

   NOTE: If the outlet box is of the earlier type having 9/16" knockout and there is no socket hole knockout available, it will be necessary to use the two pole male fitting instead of the four pole fitting just mentioned. Remove the 9/16" knockout and mount this fitting on the face of the box. Run wires through knockout hole and connect to fitting. CAUTION: WHEN CONNECTING CONSOLE TO POWER SOURCE MAKE SURE THAT THIS FITTING IS NOT PLUGGED INTO POWER CORD.

   g. Run the cable from the switch in through the bushed hole in outlet box and solder wires to the two larger of the four poles of the fitting. The outlet box may then be replaced.

   h. Connect the proper female fitting furnished with the kit, to the free end of the remaining cable and plug into the fitting just installed in the outlet box. The cable is now ready for connection to the X type cabinet. Proceed as outlined under "e" to "g" of Model B Instructions.

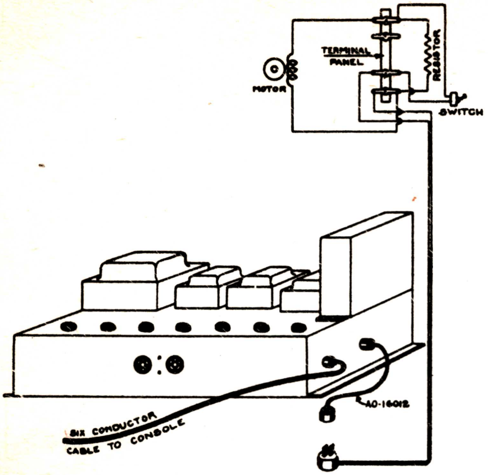

MOTOR
TERMINAL PANEL
RESISTOR
SWITCH
AO-16012
SIX CONDUCTOR CABLE TO CONSOLE

FIGURE 3.

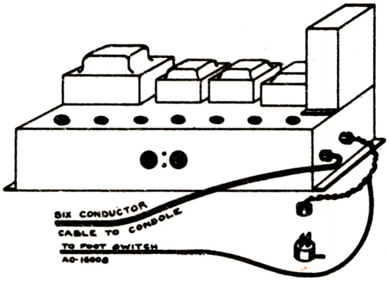

SIX CONDUCTOR CABLE TO CONSOLE
TO FOOT SWITCH
AO-16008

FIGURE 4.

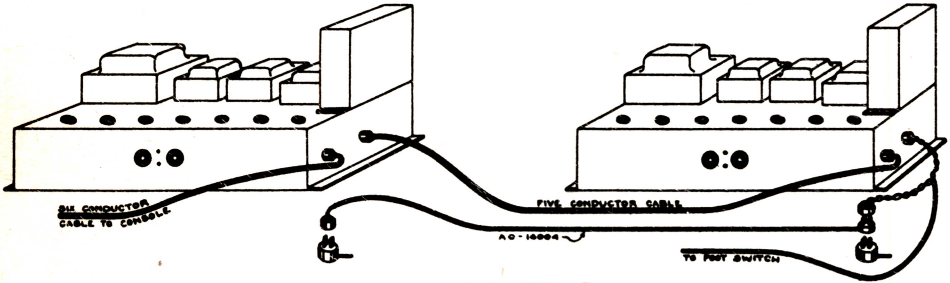

SIX CONDUCTOR CABLE TO CONSOLE
FIVE CONDUCTOR CABLE
AO-16004
TO FOOT SWITCH

FIGURE 5.

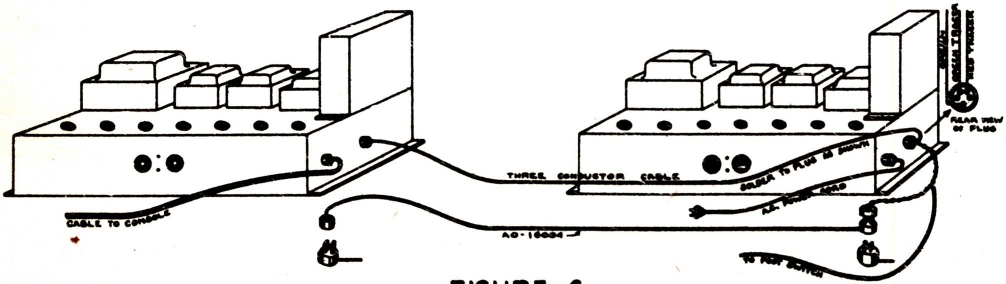

CABLE TO CONSOLE
THREE CONDUCTOR CABLE
SOLDER TO PLUG AS SHOWN
A.C. POWER CORD
REAR VIEW OF PLUG
AO-16004
TO FOOT SWITCH

FIGURE 6.

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 5

SPECIAL EQUIPMENT FOR THE HAMMOND ORGAN

F - Echo Switch Installation in Models C & D Consoles.

Hammond Instrument Co.
2915 N. Western Ave.
Chicago, Illinois

6/1/44

Printed in the United States of America

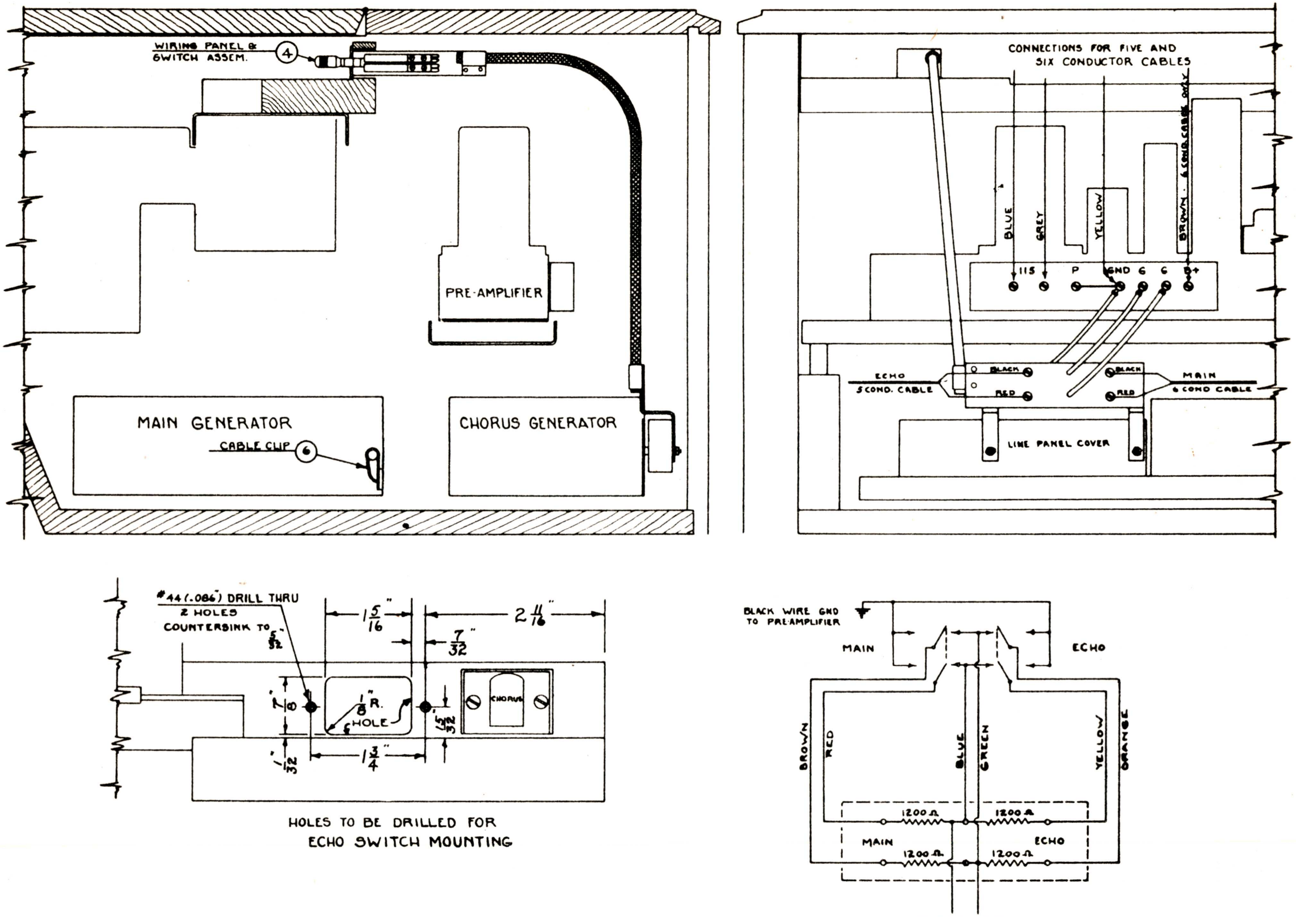
ECHO SWITCH INSTALLATION IN MODELS C & D CONSOLES

The echo switch provided for installations in Models C & D consoles is identical in operation with the switch used for installations in other Hammond consoles. When the switch is thrown to the left, the main organ sounds, and when thrown to the right the echo organ sounds. When the switch is in the center or neutral position all tone cabinets sound simultaneously.

The echo switch kit as listed in the standard price sheet includes all necessary materials to make the installation. To install the switch, proceed as follows:

1. Disconnect the chorus drawbar from the lever inside of console by removing coupling pin, then take out the four screws in the end blocks and remove the entire music rack assembly from the console.
2. Drill the holes necessary for the installation of the echo switch in the music rack panel assembly. The exact location and size of these holes are shown in Figure 1.
3. The music rack assembly may then be replaced and the echo switch installed. The wiring panel attached to the echo switch should be fastened on top of line panel cover as shown.
4. Remove the outlet box from inside base of console and knock out the receptacle hole blank near end of box.
5. Insert cable and receptacle assembly through the hole and clip the receptacle permanently in place.
6. Pull cable up through wiring tube in corner of console and replace outlet box.
7. Remove the preamplifier terminal cover and disconnect the red and black wires from the terminals and connect all wires as shown in Figure 1.
8. Replace preamplifier panel cover and check for proper operation. If it should so happen that the echo organ sounds when the switch is in the "main" position and the main organ sounds with the switch in "echo" position, the cable connections to the echo switch wiring are reversed. To rectify, reverse the two red wires and reverse the two black wires at the wiring panel.

Note: The echo switch may be removed from music rack assembly for servicing without dismounting the music rack. Just take out the four screws holding the switch to the front plate.


WIRING PANEL & SWITCH ASSEM.
4
PRE-AMPLIFIER
MAIN GENERATOR
CABLE CLIP
6
CHORUS GENERATOR
CONNECTIONS FOR FIVE AND SIX CONDUCTOR CABLES
BLUE
GREY
YELLOW
BROWN · 6 COND. CABLE ONLY
115
P
GND
6
6
B+
BLACK
RED
ECHO 5 COND. CABLE
MAIN 6 COND. CABLE
LINE PANEL COVER
#44 (.086") DRILL THRU 2 HOLES COUNTERSINK TO 5/32"
1 5/16"
2 11/16"
7/32"
7/8"
1/8" R.
HOLE
1 3/4"
15/32"
1/32"
CHORUS
BLACK WIRE GND TO PRE-AMPLIFIER
MAIN
ECHO
BROWN
RED
BLUE
GREEN
YELLOW
ORANGE
1200 Ω
1200 Ω
MAIN
ECHO
1200 Ω
1200 Ω
TO GRID TERMINALS ON PRE-AMPLIFIER PANEL

HOLES TO BE DRILLED FOR
ECHO SWITCH MOUNTING

FIGURE 1.

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 5

SPECIAL EQUIPMENT FOR THE HAMMOND ORGAN

G. Installation instructions for the Reverberation Unit Kit.

Hammond Instrument Company
2915 North Western Avenue
Chicago, Illinois

8/23/39

Printed in the United States of America

INSTALLATION INSTRUCTIONS FOR REVERBERATION UNIT KIT.

The reverberation unit kit may be installed in 50 or 60 cycle D-20 power cabinets serial numbered above 7725, and in 50 cycle DX-20 power cabinets above 7469, and in 60 cycle DX-20 power cabinets above 7978. Proceed as follows, step by step.

1. Remove the rear panel of the cabinet and take out and discard the two cork stoppers found in the holes in the bottom of the cabinet.
2. Insert rubber mounting cushions for reverberation unit in the two large holes at the right, facing from rear of cabinet.
3. Mount preamplifier in location shown in Figure 1. The mounting studs attached to preamplifier go through the four holes in the bottom of the cabinet. Fasten these studs underneath the cabinet with washers and nuts provided.
4. Remove the cloth cover from reverberation unit and carefully support unit in a vertical position to avoid possibility of damage to the unit by falling over.
5. Fill the three long brass tubes with "Hammond Damping Oil" using the special funnel packed with the oil bottles. The tube size is marked on each bottle. The three bottles for the long tubes contain the correct amount of oil to bring the level about one inch from the top.
6. Fill the short tube, pouring the entire contents of the remaining bottle into the tube, using the special funnel. Next remove oil to the proper level, as given below, using one of the oil droppers.
    a. For operating temperatures between 50°F. and 95°F. the oil level should be three inches from the top of the short tube.
    b. For operating temperatures below 50°F. the oil level should be four inches from the top of the short tube. This will, however, produce longer reverberation time at normal temperatures.
    c. For operating temperatures above 95°F. the oil level in the short tube should be two inches from the top.

7. If damping oil is spilled on either of the two open springs it must be removed. This may be done by blowing or by holding an absorbent cloth against the side of the spring.

8. Check all springs to make sure that they are hooked to their respective levers, giving special attention to the steel tape which links the outer spring to the crystal.

9. Release spring locking device by pulling out locking knob located at the bottom of the unit. Next check all levers to see that they are all approximately level. If any are appreciably out of level, they should be adjusted only after carefully reading special instructions in this procedure contained in the service manual.

10. Push in locking knob to locked position and replace cloth cover on reverberation unit.

11. Remove grille on top of the power cabinet by taking out the six screws which hold the grille frame in place.

12. Remove the small wood panel in the upper compartment of the cabinet by taking out the four screws at the corners of the panel. Now remove the cork and insert the remaining rubber mounting cushion. Then install the reverberation unit in position shown in Figure 1.

    The two steel studs on the bottom of the unit fit into the rubber mounting cushions in the bottom of the cabinet and may be guided into place by reaching through the rear door of the cabinet.

13. Replace the small panel in the top compartment, release lock on reverberation unit, and connect amplifier and unit as shown in Figure 1. Now replace the top grille and rear panel. The cabinet is now ready to operate.

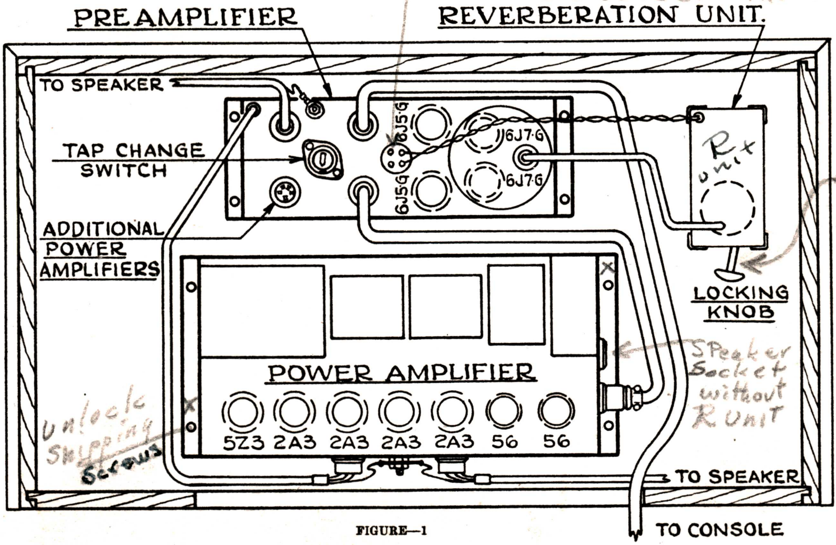
14. IMPORTANT. The power cabinet must be level. If floor is uneven, the low side of the cabinet must be raised sufficiently to bring sides to within $\frac{1}{2}$" of the vertical.

The degree of reverberation may be changed by the tap change switch on the preamplifier. This switch has four positions: OFF, LO, MED, and HI, and is locked in position by means of a locking screw which must be backed off before the switch can be turned. In most cases the HI position in which the switch is set at the factory has been found to be satisfactory.

Additional power cabinets, not having the reverberation feature, may be connected to this unit by using a standard five conductor cabinet-to-cabinet cable connected to the receptacle marked "Additional Power Amplifiers" in Figure 1. Not more than two additional 20 watt cabinets or one additional 40 watt cabinet should be connected in this manner unless those in excess of this number are served by a separate AC power connection.

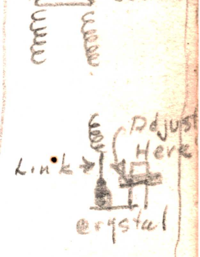
Oil in Long tubes 1" from Top
" " Short tube 3" " "

Plug Goes in Two Ways
Phase Inversion Must be Matched
If Wrong Some Base Notes will
Be Louder than others


PREAMPLIFIER
REVERBERATION UNIT
TO SPEAKER
TAP CHANGE SWITCH
ADDITIONAL POWER AMPLIFIERS
6J5G
6J5G
6J7G
6J7G
R unit
LOCKING KNOB
POWER AMPLIFIER
5Z3
2A3
2A3
2A3
2A3
56
56
Speaker Socket without R Unit
Unlock Shipping Screws
TO SPEAKER
TO CONSOLE

FIGURE—1

Lift up - Pull to unlock
Lift up Push in to Lock
Springs


Level
Adjust Here
Link
crystal

Microphonic - 6J7G's Bad Main trouble
Connecting Cord touching adjacent parts
or Rubbers oil Soaked Hardened on R unit

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 5

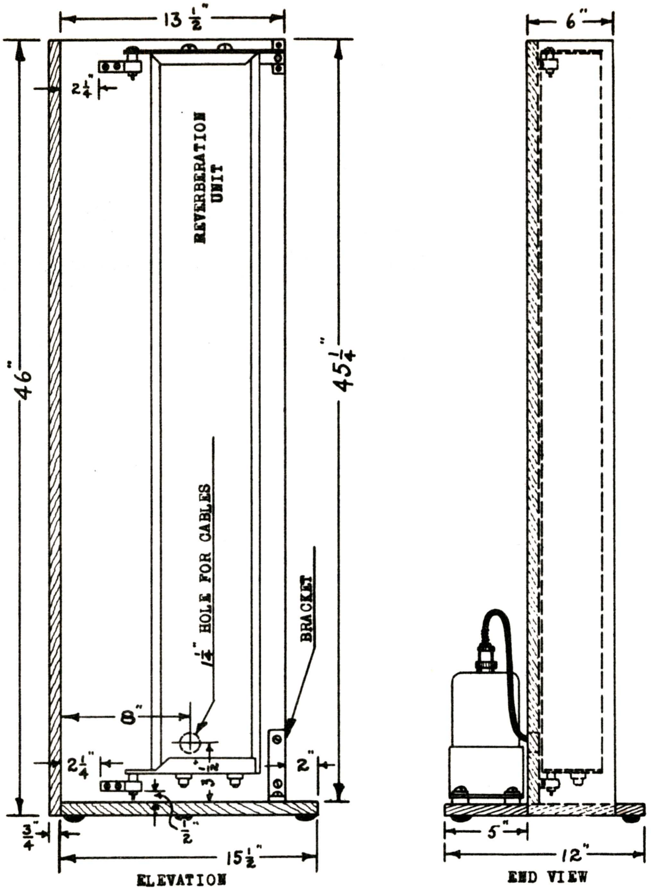
SPECIAL EQUIPMENT FOR THE HAMMOND ORGAN

H. Installation instructions for the
Reverberation Attachment Kit.

HAMMOND INSTRUMENT COMPANY
2915 N. Western Avenue
Chicago, Illinois

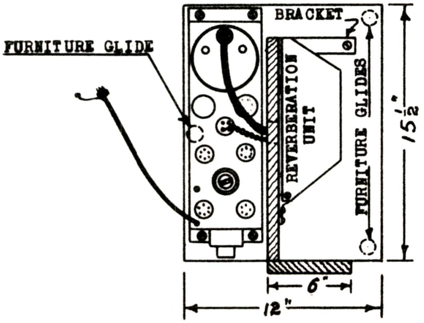
11/28/39

Printed in the United States of America


13½"
6"
46"
45¼
2¼"
REVERBERATION UNIT
1¼" HOLE FOR CABLES
BRACKET
8"
2¼"
2"
3
½
¾"
½
15½"
5"
12"

ELEVATION

END VIEW


BRACKET
FURNITURE GLIDE
REVERBERATION UNIT
FURNITURE GLIDES
15½"
6"
12"

PLAN

PLYWOOD REQUIRED
(ALL 3/4 INCH THICK)

1 PIECE 45¼" X 13½"

1 PIECE 15½" X 12"

1 PIECE 46 " X 6"

REVERBERATION ATTACHMENT
FLOOR STAND MOUNTING FOR USE WITH
A-20, A-40 AND B-40 TONE CABINETS

FIGURE 1.

INSTALLATION INSTRUCTION FOR REVERBERATION ATTACHMENT KIT

The reverberation attachment kit is designed for installation on all D-20 tone cabinets 115 volt and 230 volt serial numbered below 7725, DX-20 115 volt and 230 volt 50 cycle tone cabinets below 7460, and DX-20 115 volt and 230 volt 60 cycle below 7978. Complete instructions for installing on these cabinets are furnished on a card which is included with each kit.

The reverberation attachment may also be installed for use in conjunction with any Hammond tone cabinet either by mounting on a floor stand to be placed in back of the cabinet or by mounting on a wall at some distance from the cabinet.

To mount the reverberation attachment on a floor stand for use with an A-20, A-40 or B-40 tone cabinet, proceed as follows:

1. Procure three straight pieces of 3/4 inch plywood as specified in Figure 1, bore the 1 1/4 inch hole for cable as shown and rigidly nail the pieces together in exact accordance with dimensions on drawing.

2. Remove the reverberation unit and wood door from the housing. Also remove the preamplifier and one bracket from the wood door. Save the rubber preamplifier mounting cushions and washers and bracket. The other bracket and wood door may be discarded.

3. Screw bracket to stand as shown, using 3/4 inch x #12 round head wood screws.

4. Install three furniture glides on bottom of stand as shown on drawing. It is important that the stand be supported at these points only, otherwise the assembly may be unsteady if the floor should be uneven.

5. Fasten the reverberation unit housing in exact position shown by screwing hinges to panel with wood screws and washers furnished in cloth bag. Drill 1/8 inch diameter holes for hinge screws.

6. Mount tapped plate on panel in alignment with hole in flange in upper right hand corner of housing. Drill 1/8 inch holes for wood screws for attaching plate and a 1/4 inch hole for clearance for knurled head machine screw.

7. Mount preamplifier in position shown using 1 inch x #10 round head wood screws and washers. Screws should not be driven far enough to unduly compress the rubber mounting cushions.

8. Carefully follow instructions on card furnished with the kit for filling oil tubes and installing reverberation unit in housing.

9. Place stand on floor immediately behind the tone cabinet and connect according to directions on instruction card.

10. Mount instruction card on the vertical wood panel for future reference.

When the reverberation attachment is to be mounted on a wall, the power amplifier must be removed from the cabinet and mounted adjacent to the reverberation attachment. A special speaker extension cable may be purchased from the Organ Service Department for connection of speaker and amplifier. The distance from the amplifier to speakers should not be more than fifty feet. This type of mounting must be used with the C-40 tone cabinet. To mount on a wall as shown in Figure 2, proceed as follows:

1. Cut and drill two pieces of plywood 3/4" in thickness in exact accordance with dimensions shown in Figure 3. Drill all holes shown through.

2. Remove the reverberation unit and wood door from the housing. Also remove the preamplifier and brackets from the wood door. The door may then be discarded.

3. Attach the shelf to the large panel using the brackets removed from the preamplifier. 3/4" x #12 round head wood screws should be used to fasten brackets to panel and shelf.

4. Fasten reverberation unit housing on panel in position shown by screwing hinges to panel with wood screws and washers furnished in cloth bag. Drill 1/8" diameter holes for hinge screws.

   Housing should be carefully lined up with edges of panel.

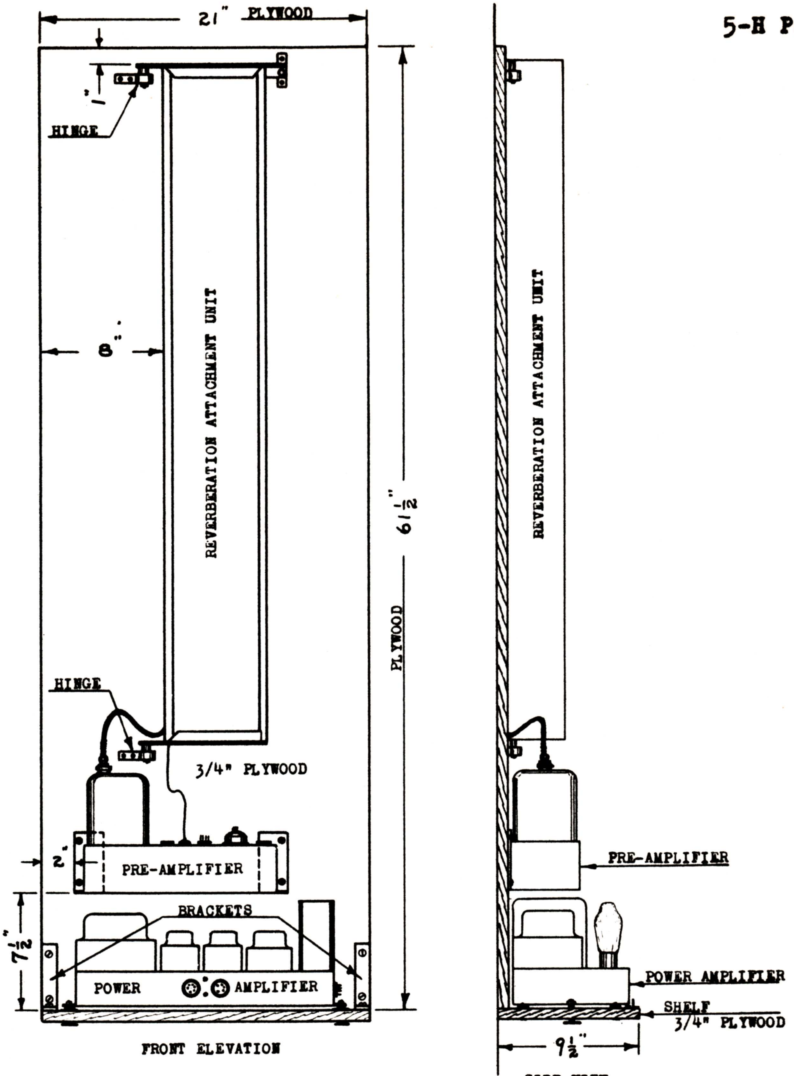
5. Mount small tapped plate on panel in alignment with hole in flange at upper right hand corner of housing. Drill 1/8" diameter holes for wood screws for attaching plate and a 1/4" hole in center to provide clearance for knurled head machine screw.

6. Fasten preamplifier to panel as shown using 3/4" x #10 round head wood screws. One large washer should be used between each screw head and amplifier mounting plate, and two washers between mounting plate and wood panel to provide clearance for screw heads on back of preamplifier.

7. Attach panel to wall in a solid manner at desired location with screws or nails, making certain that panel is in a vertical position. If wall is not plumb, shims should be used as required to bring panel to a vertical position.

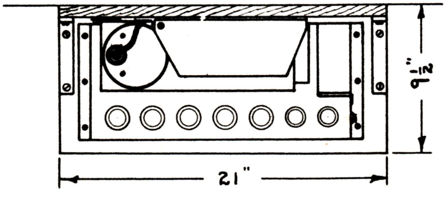
8. Remove power amplifier from tone cabinet and install on shelf, using the mounting parts from the tone cabinet.

   The small fibre washers beneath the mounting springs should be in the same relative location as when located in cabinet, i.e., one thin and one thick washer beneath the rear left hand spring and one thick washer beneath the rear right hand spring. If the power amplifier was removed from a C-20 or D-20 tone cabinet, the holes in the bottom of cabinet should be plugged with cork stoppers.


21" PLYWOOD
1"
HINGE
8"
REVERBERATION ATTACHMENT UNIT
61½"
PLYWOOD
HINGE
3/4" PLYWOOD
2"
PRE-AMPLIFIER
7½"
BRACKETS
POWER AMPLIFIER
REVERBERATION ATTACHMENT UNIT
PRE-AMPLIFIER
POWER AMPLIFIER
SHELF
3/4" PLYWOOD
9½"

FRONT ELEVATION

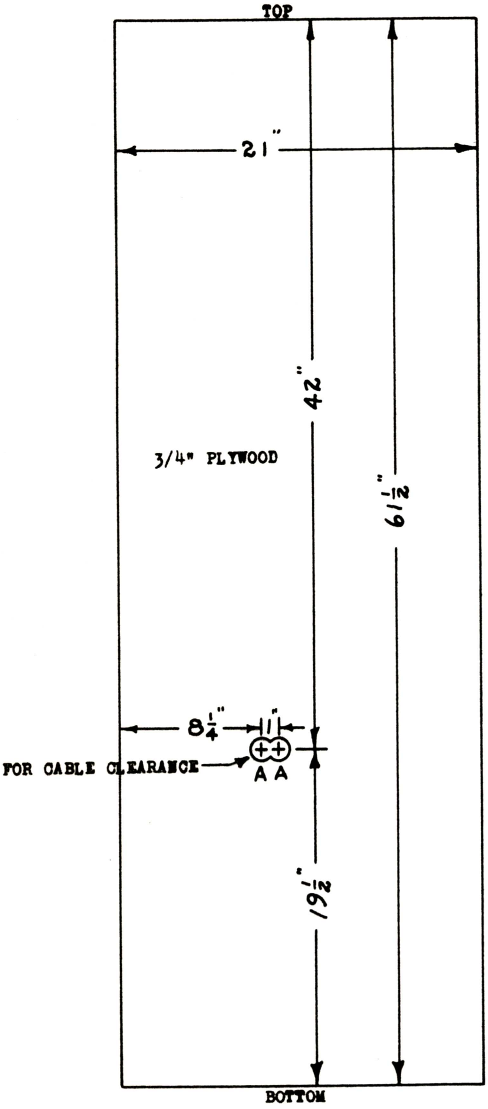
SIDE VIEW



PLAN

-REVERBERATION ATTACHMENT-
METHOD OF WALL MOUNTING

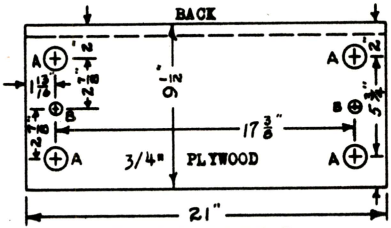
FIGURE 2.


TOP
21"
42"
61 1/2"
3/4" PLYWOOD
8 1/4"
1"
FOR CABLE CLEARANCE
A A
19 1/2"
BOTTOM

FRONT ELEVATION OF BACK PANEL.

HOLES MARKED "A" - 1 1/4" DIAMETER

HOLES MARKED "B" - 11/64" DIAMETER


BACK
A
1/2"
2 7/8"
1 13/16"
B
9 1/2"
17 3/8"
5 3/4"
2 7/8"
3/4" PLYWOOD
21"

TOP VIEW OF SHELF

FOR ASSEMBLY SEE FIGURE 2

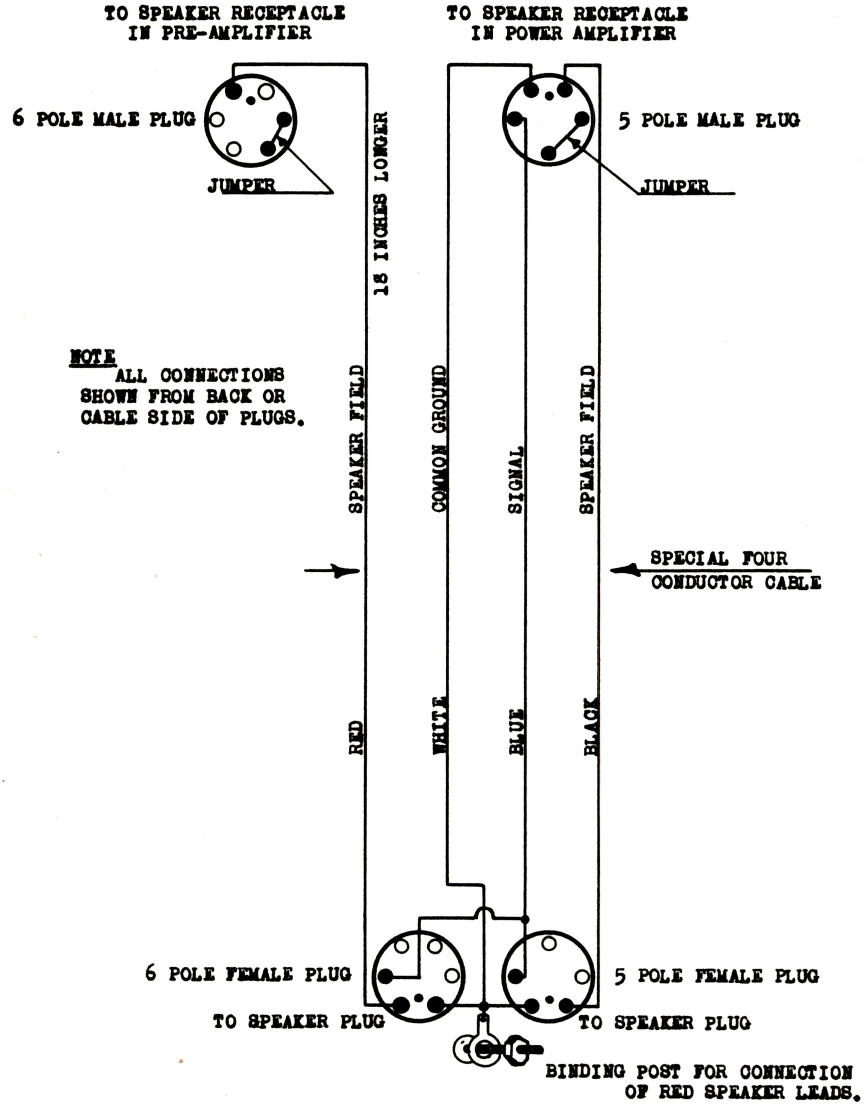
BACK PANEL & SHELF FOR WALL MOUNTING
OF REVERBERATION ATTACHMENT.
SHOWING HOLES TO BE BORED BEFORE ASSEMBLY.

FIGURE 3.

9. Prepare speaker extension cable to length desired and connect to plugs as shown in Figure 4 and plug into amplifiers and speaker leads. The wire connecting the 6 prong plug going to receptacle in preamplifier should be about 18 inches longer than the connections to 5 prong amplifier plug.

10. Carefully follow instructions on card included with kit for filling oil tubes in reverberation unit, installing unit in housing and making cable connections.

11. Mount instruction card on the vertical wood panel for future reference.


TO SPEAKER RECEPTACLE IN PRE-AMPLIFIER
TO SPEAKER RECEPTACLE IN POWER AMPLIFIER
6 POLE MALE PLUG
5 POLE MALE PLUG
JUMPER
JUMPER
18 INCHES LONGER
NOTE
ALL CONNECTIONS SHOWN FROM BACK OR CABLE SIDE OF PLUGS.
SPEAKER FIELD
COMMON GROUND
SIGNAL
SPEAKER FIELD
SPECIAL FOUR CONDUCTOR CABLE
RED
WHITE
BLUE
BLACK
6 POLE FEMALE PLUG
5 POLE FEMALE PLUG
TO SPEAKER PLUG
TO SPEAKER PLUG
BINDING POST FOR CONNECTION OF RED SPEAKER LEADS.

SPEAKER EXTENSION CABLE
SHOWING CONNECTIONS TO PLUGS

FIGURE 4.

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 5

SPECIAL EQUIPMENT FOR THE HAMMOND ORGAN

J. Installation of Console Heater

HAMMOND INSTRUMENT COMPANY
2915 N. Western Avenue
Chicago, Illinois

1.15.42

CONSOLE HEATERS

In very humid climates and in other locations where the Hammond Organ is exposed to extreme dampness, it is often advisable to install a heater in the console to keep the interior of the instrument dry and to reduce the possibility of excess moisture causing damage to electrical parts.

A heater designed for this purpose is available in kit form from the factory. This kit includes all necessary mounting parts and may be installed by the service technician in any Hammond organ console in a few minutes time.

When ordering the console heater kit be sure to specify console model and voltage also console serial number if possible.

Installation of Heater in Model A Consoles

1. Attach the special bracket furnished with the kit to heater socket as shown in Figure 2, using two screws and lock washers. All mounting holes in the special bracket are tapped for screws, so no nuts are necessary.

2. Remove back of console and attach heater to flange at upper left hand corner of rheostat box as shown in Figure 2, using the remaining two screws, flat washers and lock washers furnished with kit.

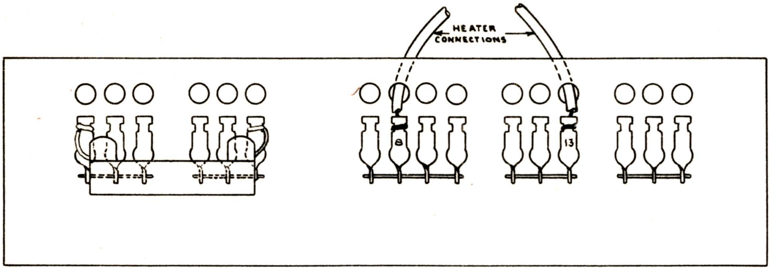
3. Remove power terminal panel cover and solder heater cord ends to terminals #8 and #13 counting from left of panel as shown in Figure 1.

4. Replace terminal panel cover, plug heater in socket and attach red instruction tag to power cord plug.

Installation of Heater in Model B, C and D Consoles

1. Remove back of console and place heater socket 3/4" to the left of oil cup mounting plate as shown in Figure 3 and mark location of two mounting holes. These holes should be in line with oil cup mounting screws. (Consoles are now being furnished with these holes punched in mounting plate.)

2. Drill holes for heater socket mounting, using a #24 or a 5/32" drill.


HEATER CONNECTIONS
8
13

POWER TERMINAL PANEL
FIGURE 1.

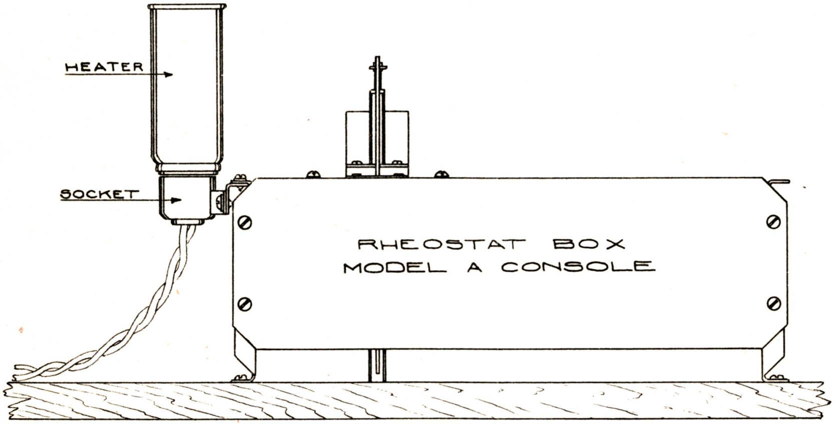

HEATER
SOCKET
RHEOSTAT BOX
MODEL A CONSOLE

FIGURE 2.

3. Drill another similar hole for cable clip 8 3/4" to the left of holes just drilled and in line with same.

4. Using two of the screws, lock washers and nuts provided with the kit, mount the heater socket and one cable clip. The clip is held in place by the left hand socket mounting screw.

5. Mount the other cable clip with the remaining screw and fasten heater cord in place.

6. Remove power terminal panel cover and solder heater cord ends to terminals #8 and #13 counting from left of panel as shown in Figure 1.

7. Replace terminal panel cover, plug heater in socket and attach red instruction tag to power cord plug.

Installation of Heater in Model E Console

1. Remove back of console and place heater in position at left end of oil tube mounting plate as shown in Figure 4 and mark location of two mounting holes. Holes should be 3/16" from top edge of plate and left hole should be 1/4" from end.

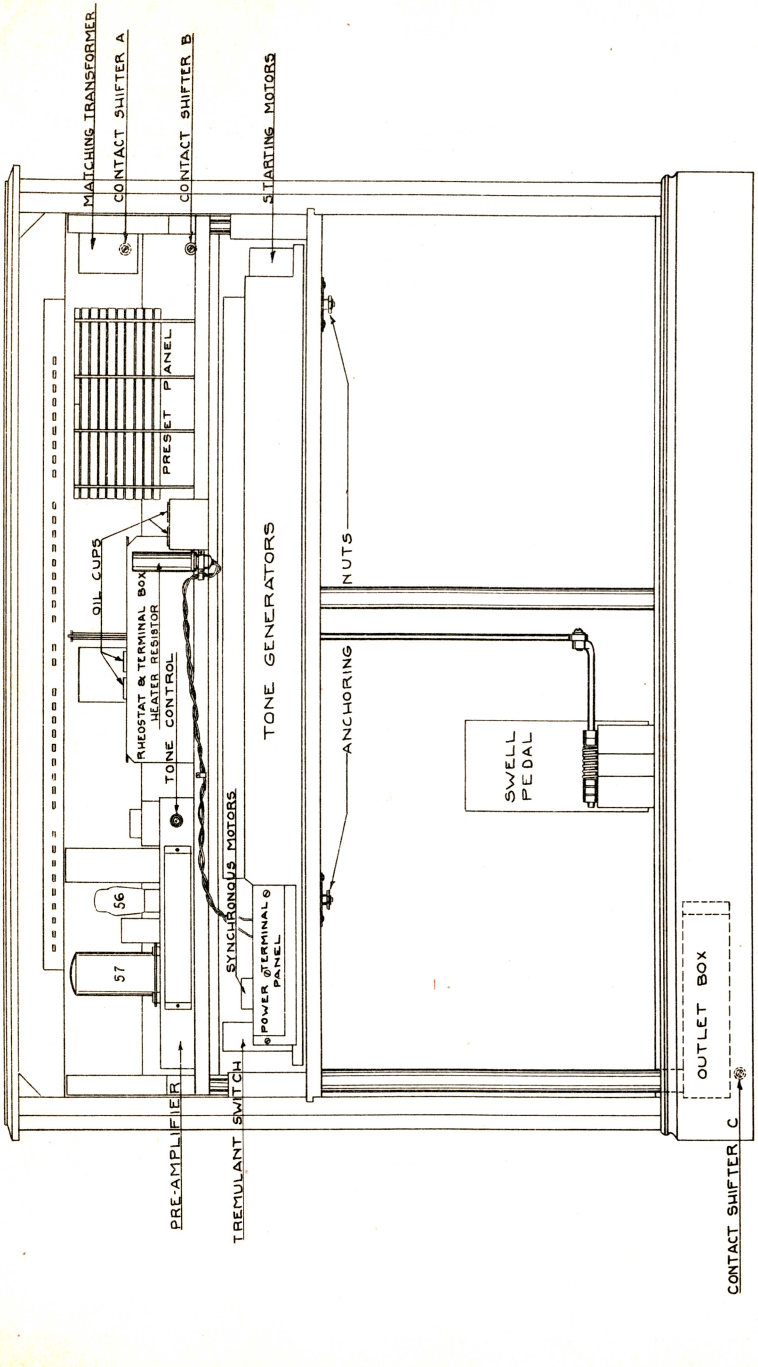
2. Drill holes for mounting heater socket, using a #24 or a 5/32" drill.

3. Using two screws, lock washers and nuts provided with kit, mount heater socket and one of the cable clips. The clip is fastened by the left hand socket mounting screw.

4. Mount the remaining cable clip on post supporting run motor oil tube and fasten heater cord in clips.

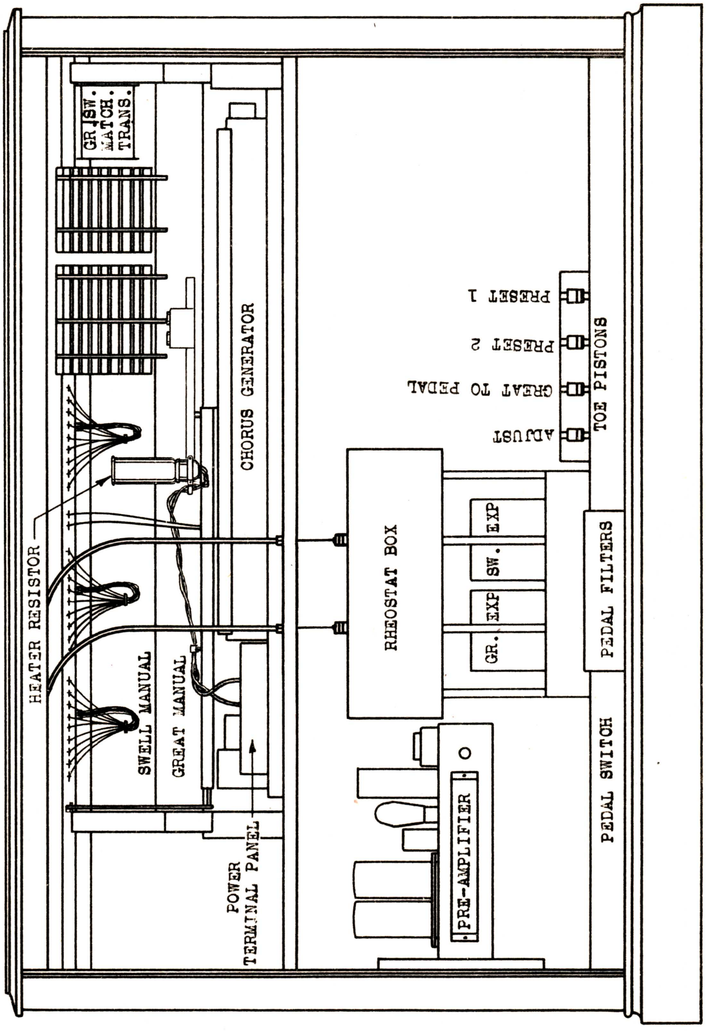
5. Remove power terminal panel cover and solder heater cord ends to terminals #8 and #13 counting from left of panel as shown in Figure 1.

6. Replace terminal panel cover, plug heater in socket and attach red instruction tag to power cord plug.


MATCHING TRANSFORMER
CONTACT SHIFTER A
CONTACT SHIFTER B
STARTING MOTORS
PRESET PANEL
OIL CUPS
RHEOSTAT & TERMINAL BOX
HEATER RESISTOR
TONE CONTROL
TONE GENERATORS
NUTS
ANCHORING
SWELL PEDAL
SYNCHRONOUS MOTORS
POWER & TERMINAL PANEL
56
57
OUTLET BOX
PRE-AMPLIFIER
TREMULANT SWITCH
CONTACT SHIFTER C

REAR VIEW OF CONSOLE
WITH BACK REMOVED

FIGURE 3


HEATER RESISTOR
SWELL MANUAL
GREAT MANUAL
GR. SW. MATCH. TRANS.
CHORUS GENERATOR
POWER TERMINAL PANEL
RHEOSTAT BOX
PRE-AMPLIFIER
GR. EXP
SW. EXP
PEDAL SWITCH
PEDAL FILTERS
TOE PISTONS
ADJUST
GREAT TO PEDAL
PRESET 2
PRESET 1

LOCATION OF
HEATER RESISTOR
MODEL E CONSOLE

FIGURE 4.

THE HAMMOND ORGAN

A MANUAL FOR THE SERVICE TECHNICIAN

PART 6

CHANGES

C. Revision to Improve Pedal Tones

HAMMOND INSTRUMENT COMPANY
2915 N. Western Ave.
Chicago, Illinois

4/1/41

Printed in the United States of America

Consoles serial numbered as follows have been revised for the purpose of improving pedal tone quality.

Model A	#2648 and above	Model B	#10550 and above
Model C	#1277 " "	Model D	# 3144 " "
Model E	#8664 " "	Player	# 9210 " "

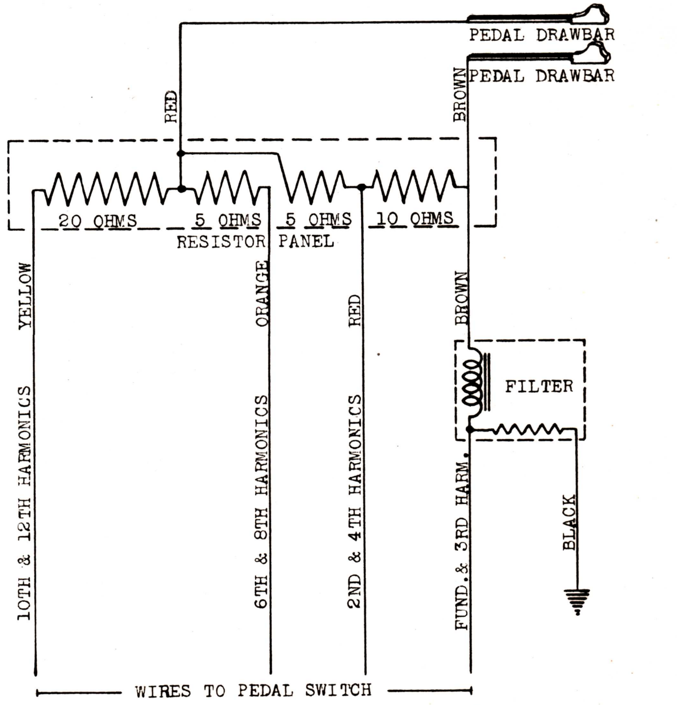
This revision effects changes in several assemblies as follows:

MAIN GENERATOR is identical to previous models except that the magnets for frequencies #1 to #9 have been omitted and there are 82 instead of 91 terminals on the terminal strip, exclusive of the ground terminals. The lowest frequency available at the terminal strip is frequency #10 located adjacent to the ground terminal at the start motor end of generator.

PEDAL RESISTOR PANELS for models A, B, C, D, and Player organs are revised as shown in Figure 1. Model E resistor panel is revised as shown in Figure 2.

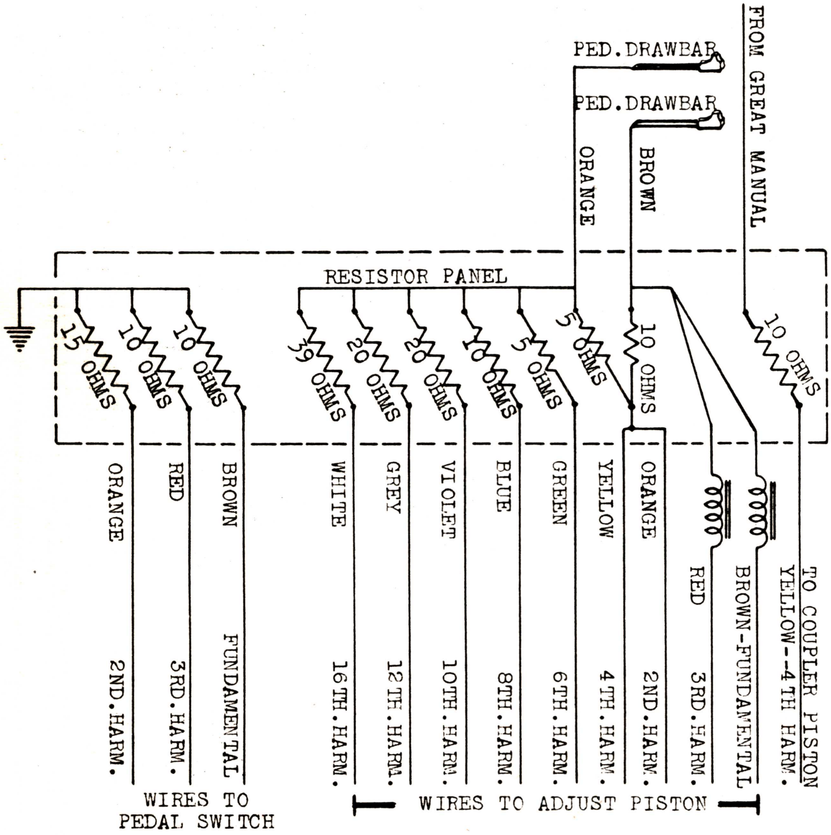
MANUAL KEY SWITCHES of all models are revised as shown in Figure 3. Note lower 9 sub-fundamental frequencies and also 8th harmonic frequencies in upper octave.

PEDAL SWITCH wiring for Model E console is shown in Figure 4. Pedal switches for other models are wired identical to Model E except, as on previous instruments, there are only 25 pedals and the 12th and 16th harmonics are not available.


PEDAL DRAWBAR
PEDAL DRAWBAR
RED
BROWN
20 OHMS
5 OHMS
5 OHMS
10 OHMS
RESISTOR PANEL
YELLOW
ORANGE
RED
BROWN
FILTER
BLACK
10TH & 12TH HARMONICS
6TH & 8TH HARMONICS
2ND & 4TH HARMONICS
FUND. & 3RD HARM.
WIRES TO PEDAL SWITCH

RESISTOR PANEL WIRING - MODELS A,B,C & D ORGANS

FIGURE 1


PED.DRAWBAR
PED.DRAWBAR
FROM GREAT MANUAL
ORANGE
BROWN
RESISTOR PANEL
15 OHMS
10 OHMS
10 OHMS
39 OHMS
20 OHMS
20 OHMS
10 OHMS
5 OHMS
5 OHMS
10 OHMS
10 OHMS
ORANGE 2ND.HARM.
RED 3RD.HARM.
BROWN FUNDAMENTAL
WHITE 16TH.HARM.
GREY 12TH.HARM.
VIOLET 10TH.HARM.
BLUE 8TH.HARM.
GREEN 6TH.HARM.
YELLOW 4TH.HARM.
ORANGE 2ND.HARM.
RED 3RD.HARM.
BROWN-FUNDAMENTAL
TO COUPLER PISTON
YELLOW--4TH HARM.
WIRES TO PEDAL SWITCH
WIRES TO ADJUST PISTON

RESISTOR PANEL WIRING - MODEL E ORGAN

FIGURE 2.

Frequencies used in
Model B + E
Manuals

Key Number	Note	Drawbar 1 Sub-Fund.	Drawbar 2 Sub-3rd	Drawbar 3 Fund.	Drawbar 4 2nd Harm.	Drawbar 5 3rd Harm.	Drawbar 6 4th Harm.	Drawbar 7 5th Harm.	Drawbar 8 6th Harm.	Drawbar 9 8th Harm.
1	C	13	20	13	25	32	37	41	44	49
2	C#	14	21	14	26	33	38	42	45	50
3	D	15	22	15	27	34	39	43	46	51
4	D#	16	23	16	28	35	40	44	47	52
5	E	17	24	17	29	36	41	45	48	53
6	F	18	25	18	30	37	42	46	49	54
7	F#	19	26	19	31	38	43	47	50	55
8	G	20	27	20	32	39	44	48	51	56
9	G#	21	28	21	33	40	45	49	52	57
10	A	10	29	22	34	41	46	50	53	58
11	A#	11	30	23	35	42	47	51	54	59
12	B	12	31	24	36	43	48	52	55	60
13	C	13	32	25	37	44	49	53	56	61
14	C#	14	33	26	38	45	50	54	57	62
15	D	15	34	27	39	46	51	55	58	63
16	D#	16	35	28	40	47	52	56	59	64
17	E	17	36	29	41	48	53	57	60	65
18	F	18	37	30	42	49	54	58	61	66
19	F#	19	38	31	43	50	55	59	62	67
20	G	20	39	32	44	51	56	60	63	68
21	G#	21	40	33	45	52	57	61	64	69
22	A	22	41	34	46	53	58	62	65	70
23	A#	23	42	35	47	54	59	63	66	71
24	B	24	43	36	48	55	60	64	67	72
25	C	25	44	37	49	56	61	65	68	73
26	C#	26	45	38	50	57	62	66	69	74
27	D	27	46	39	51	58	63	67	70	75
28	D#	28	47	40	52	59	64	68	71	76
29	E	29	48	41	53	60	65	69	72	77
30	F	30	49	42	54	61	66	70	73	78
31	F#	31	50	43	55	62	67	71	74	79
32	G	32	51	44	56	63	68	72	75	80
33	G#	33	52	45	57	64	69	73	76	81
34	A	34	53	46	58	65	70	74	77	82
35	A#	35	54	47	59	66	71	75	78	83
36	B	36	55	48	60	67	72	76	79	84
		Frequency Number								

(continued on next page)

Figure 3.

(continued from preceding page)

Key Number	Note	Drawbar 1 Sub-Fund.	Drawbar 2 Sub-3rd	Drawbar 3 Fund.	Drawbar 4 2nd Harm.	Drawbar 5 3rd Harm.	Drawbar 6 4th Harm.	Drawbar 7 5th Harm.	Drawbar 8 6th Harm.	Drawbar 9 8th Harm.
37	C	37	56	49	61	68	73	77	80	85
38	C#	38	57	50	62	69	74	78	81	86
39	D	39	58	51	63	70	75	79	82	87
40	D#	40	59	52	64	71	76	80	83	88
41	E	41	60	53	65	72	77	81	84	89
42	F	42	61	54	66	73	78	82	85	90
43	F#	43	62	55	67	74	79	83	86	91
44	G	44	63	56	68	75	80	84	87	80
45	G#	45	64	57	69	76	81	85	88	81
46	A	46	65	58	70	77	82	86	89	82
47	A#	47	66	59	71	78	83	87	90	83
48	B	48	67	60	72	79	84	88	91	84
49	C	49	68	61	73	80	85	89	80	85
50	C#	50	69	62	74	81	86	90	81	86
51	D	51	70	63	75	82	87	91	82	87
52	D#	52	71	64	76	83	88	80	83	88
53	E	53	72	65	77	84	89	81	84	89
54	F	54	73	66	78	85	90	82	85	90
55	F#	55	74	67	79	86	91	83	86	91
56	G	56	75	68	80	87	80	84	87	80
57	G#	57	76	69	81	88	81	85	88	81
58	A	58	77	70	82	89	82	86	89	82
59	A#	59	78	71	83	90	83	87	90	83
60	B	60	79	72	84	91	84	88	91	84
61	C	61	80	73	85	80	85	89	80	85
		Frequency Number								

Frequencies Used in Manuals
Models B and E

Frequencies used in Model E Pedals

Pedal No.	Note	Fund.	3rd Harm.	2nd Harm.	4th Harm.	6th Harm.	8th Harm.	10th Harm.	12th Harm.	16th Harm.
1	C	13	20	13	25	32	37	41	44	49
2	C#	14	21	14	26	33	38	42	45	50
3	D	15	22	15	27	34	39	43	46	51
4	D#	16	23	16	28	35	40	44	47	52
5	E	17	24	17	29	36	41	45	48	53
6	F	18	25	18	30	37	42	46	49	54
7	F#	19	26	19	31	38	43	47	50	55
8	G	20	27	20	32	39	44	48	51	56
9	G#	21	28	21	33	40	45	49	52	57
10	A	10	29	22	34	41	46	50	53	58
11	A#	11	30	23	35	42	47	51	54	59
12	B	12	31	24	36	43	48	52	55	60
13	C	13	32	25	37	44	49	53	56	61
14	C#	14	33	26	38	45	50	54	57	62
15	D	15	34	27	39	46	51	55	58	63
16	D#	16	35	28	40	47	52	56	59	64
17	E	17	36	29	41	48	53	57	60	65
18	F	18	37	30	42	49	54	58	61	66
19	F#	19	38	31	43	50	55	59	62	67
20	G	20	39	32	44	51	56	60	63	68
21	G#	21	40	33	45	52	57	61	64	69
22	A	22	41	34	46	53	58	62	65	70
23	A#	23	42	35	47	54	59	63	66	71
24	B	24	43	36	48	55	60	64	67	72
25	C	25	44	37	49	56	61	65	68	73
26	C#	26	45	38	50	57	62	66	69	74
27	D	27	46	39	51	58	63	67	70	75
28	D#	28	47	40	52	59	64	68	71	76
29	E	29	48	41	53	60	65	69	72	77
30	F	30	49	42	54	61	66	70	73	78
31	F#	31	50	43	55	62	67	71	74	79
32	G	32	51	44	56	63	68	72	75	80
		Frequency Number								

Frequencies Used in Pedal Switch

Model E

Figure 4

THE HAMMOND ORGAN

PART 7. A MANUAL FOR THE SERVICE TECHNICIAN

Parts Price List

Hammond Instrument Company
2915 North Western Avenue
Chicago, Illinois

6/1/44 Printed in the United States of America

PARTS PRICE LIST

This parts list has been prepared to help the service man quote on repair jobs when replacement parts are required. When ordering parts, give part number and description to avoid error. All prices are domestic list, subject to change without notice.

Part numbers and prices for amplifiers, generators, and transformers are for 115 volt 60 cycle instruments. When ordering special parts always indicate voltage and frequency as stamped on serial plate.

When there is a question about type of part required, specify serial number of console or tone cabinet involved. To order parts not shown here, give description of part and serial number of unit involved.

Replaced parts are returnable for credit only when the instrument from which they have been removed is within the period of the guarantee and there is evidence of defect in material or workmanship.

All returned parts must be accompanied by a service report completely filled out.

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A. WOODWORK AND CASE HARDWARE

Console Woodwork:

Description	Part Number	Use	Price
Console case (specify type mounting	AO-2724-1	B	$160.00
" " " " "	AO-16260-1	D	160.00
" " " " "	AO-2978-1	E	245.00
Cover panel for pedal switch	PO-2725-3	B	6.75
" " " " "	AO-16198-1	D	2.90
Music rack (finished,but without hdwe.)		A	12.00
" " " " " "	AO-2658-5	B	19.00
" " " " " "	AO-16245-1	D	19.00
" " " " " "	AO-2975-3	E	24.50
Top (two matched halves,finished,without hdwe.)		B	28.00
Fallboard (finished, without hardware)		B	16.00
" " " "		D	9.50

Console hardware:

Description	Part Number	Use	Price
Rubber bumper (flat)	PO-15769-0	A-B-E	.02
" " (round)	PO-15770-0	B	.03
" " (music rack)	PO-15773-0	B	.03
Music rack support	AO-1755-2	A	.48
Hinge (console top)	PO-15675-1	A	1.95
" " "	PO-15676-1	A	1.75
Back panel thumb screw	PO-2152-2	A-B-E	.20
"A" lock complete			1.30
"B" "	PO-15771-1		1.00
"D" "	AO-16267-1		1.05
"E" "	PO-15775-1		1.10
"A" lock key			.10
"B" " "	PO-2849-1		.10
"D" " "	PO-16268-1		.10
"E" " "	PO-15787-1		.10
"A" strike			.10
"B-D" "	PO-15772-1		.10

Tone cabinet woodwork:

Description	Part Number	Use	Price
A-20 case only	AO-1902-1		78.00
B-40 " "	AO-2499-1		57.00
D-20 case including grille	AO-15465-1		72.00
Door only for C-20	PO-15413-1		2.50
" " " D-20	PO-15952-1		1.90
" " " DXR cabinet	PO-16038-1		2.80
Top grille frame for D-20	PO-15948-1		6.50
" " " " DXR cabinet	PO-15951-0		14.50

A. WOODWORK AND CASE HARDWARE (CONT'D)

Tone cabinet hardware:

Description	Part Number	Use	Price
Grille only for B-40	PO-2497-2		$ 11.00
Hinge assembly for C-20 (R)	PO-15459-2		2.40
" " " " (L)	PO-15459-1		2.40
Hinge track & spring assy. for C-20	PO-15460-0		1.20
Grille only for D-20 top	PO-15472-2		1.40

Benches:

Description	Part Number	Use	Price
Bench, complete	AO-1714-1	A-B	25.00
" "	PO-2977-1	E	48.00
" "	AO-16250-1	D	25.00
Bench, top only		A-B	8.25
" " "		D	7.80
Hinges	PO-15776-2	B	.10

B. MANUAL CHASSIS ASSEMBLIES AND PARTS

Description	Part Number	Use	Price
Manual Chassis assembly	AO-1931-9	A-B-D	525.00
" " "	AO-15290-1	E	610.00
Charge for installation of movable bus-bars and key contact shifters in early Model A manual chassis and pedal switch assemblies. Note: This applies to consoles serial numbered below 995. (Dealer to add assembly labor on customer's premises and transportation			($24.00 net)

Manual chassis parts:

Description	Part Number	Use	Price
Matching transformer	AO-2369-3	A-B-D	6.25
" "	AO-15124-1	E	14.50
Tremulant control potentiometer	PO-2074-0	A-B-D	.63
" " "	AO-2979-0	E	.48
Tremulant switch plate	PO-2543-2		.38
Start switch	AO-2069-1	A-B-D-E	.96
Run switch	AO-2070-2	A-B-D-E	1.35
Start & run switch plate	PO-2542-2	A-B-D-E	.35
Short white preset key & channel	AO-1838-0	A-B-D	.55
Long black " " " "	AO-1836-C2, D2, E2		.55
" " " " " "	AO-1834-F2, C2,A2,B2		.55
Short white " "	PO-2619-2	A-B-D	.27
Long black " "	PO-2639-A2 to G2 incl.		.19
Short black playing key & channel	AO-1802-0	A-B-D-E	.40
Long white " " " "	AO-1803-A1-G1, incl.		.45
" " " " " "	AO-1803-CX1		.45
Short black key	PO-2619-1		.18
Long white key	PO-2638-A1 to G1 incl.		.27

B. MANUAL CHASSIS ASSEMBLIES AND PARTS (CONT'D)

Description	Part Number	Use	Price
Manual chassis parts (cont'd):			
Switch knob, start & run switch	PO-2071-0	A-B-D-E	$ .35
Tremulant control knob	PO-2080-0	A-B-D	.32
Front strip (with up stop felt) upper	AO-15912-2	A-B-D	3.40
" " " " " " lower	AO-15912-1	A-B-D	1.95
Draw bar knobs.....blk-brn-white	PO-1572-1	A-B-D	.12
Preset buttons.....(set of 11)	PO-2983-0 to 11	E	.89
Preset labels	AO-16040-0	A-B-D	.30 Net
" "	AO-15848-1	E	.30 Net
Preset felts-upstop	PO-15910-0	2	.04
Manual felts-upstop	PO-15911-0	2	.24
" " -downstop	PO-1701-0	2	.60
" " -sharp upstop	PO-1647-1	60	.01
" end block - left hand	PO-1741-3	B	1.20
" " " - right "	PO-1740-3	B	.75
" " " - left "	PO-1741-1	D	1.20
" " " - right "	PO-1740-1	D	.75
Decal. "Hammond"	PO-1799-1		.09
Manual chassis cable assy	AO-2425-0	A-B	8.25
Stop switch base assembly	AO-2090-6	A-B	49.00
" " " "	AO-15385-1	E	56.00
Preset cradle spring	PO-1850-4	A-B-D	.04

C. PEDAL SWITCH ASSEMBLIES AND PARTS

Pedal switch assembly	AO-1822-2	A-B-D	71.00
" " "	AO-15380-1	E	165.00
Pedal switch parts:			
Cable assembly	AO-15137-0	B-D	8.00
" "	AO-15230-0	E	7.85
Pedal filter choke assembly	AO-15766-0	E	12.75
" " " "	AO-15782-1	A-B-D	1.75
Pusher pin felts	PO-15019-0	B	.02
Canvas strip	PO-2135-0	A-B	.92

D. PEDAL CLAVIER ASSEMBLIES AND PARTS

Pedal clavier assembly	AO-1719-1	A-B-D	75.00
" " "	AO-15375-1	E	140.00
Pedal clavier parts:			
Switch pusher assembly	AO-1800-0	A-B-D	.09
Screws for switch pusher	WS-0821-4	A-B-D	.01
White pedal assembly	AO-1801-0	A-B-D	2.10
Black pedal assembly	AO-1798-1	A-B-D	2.10
Pedal cap	AO-1698-0	A-B-D	.42
" "	AO-2664-1	E	.63
Pedal hinge spring	PO-2031-8	A-B-D	.10
Rubber bumper	PO-1860-0	A-B-D	.04

E. GENERATOR ASSEMBLIES AND PARTS

Description	Part Number	Use	Price
Main generator & Motor assembly*	A0-1998-1	A	$250.00
" " " " " *	A0-1998-11	B-D-E	250.00
Chorus " " " " *	A0-2842-1	B-D	148.00
" " " " "" *	A0-2842-12	E	175.00
Main " " " "	A0-15845-6	A	250.00
" " " " "	A0-15845-11	B-D-E	250.00
Chorus " " " "	A0-15850-1	B-D	148.00
" " " " "	A0-15850-12	E	175.00
Main generator exchange			18.00
Chorus " "			15.00

(*Compression spring mounting. Others have suspension spring mtg.)

Generator parts:

Run motor & tremulant switch assembly	A0-15870-1	A-B-D-E	27.50
" " " " " "	A0-15870-5	E	27.50
Tremulant switch plate assembly	A0-15878-0	A-B-D-E	6.35
Coupling ass'y.(synch.motor to shaft)	A0-15846-0	A-B-D-E	2.50
Start motor assembly	A0-2344-1	A	10.50
" " "	A0-2344-6	B-D	10.50
" " "	A0-2344-6	E	10.50
Run motor assembly (chorus)	A0-15800-13	B-D	12.50
Run motor coupling spring	P0-2345-0	A-B-D-E	.02
250 ohm line panel resistor	P0-2088-0	A	.37
125 " " " "	P0-2859-0	B-E-D	.53
Condenser (.105 mfd.200 v.)	A0-2304-0	A-B-D-E	.10
" (.255 mfd. " "	A0-2783-0	A-B-D-E	.14
Filter transformer assemblies	A0-2957-60	to 91 incl.	.52 ea.
Terminal strip assembly (main)	A0-2729-0	A-B-D-E	.35
" " " (chorus)	A0-2867-0	B-D-E	.25
Generator cover felt	P0-2429-0	A-B-D-E	.28

Generator Mounting parts:

Compression - Spring	P0-2035-8	A-B-E	.06
Cup	P0-1962-4	A-B-E	.04
Felt	P0-2335-0	A-B-E	.06
Cupped washer	P0-1963-2	A-B-E	.06
Suspension - Spring bolt	P0-15642-4	A-B-E	.19
Spring	P0-15815-0	A-B-E	.04
Hex. Nut	N-20111-4	A-B-E	.01
Special washer	P0-15811-2	A-B-E	.01
Special Hex. Nut	P0-15812-2	A-B-E	.09
Hex. Head Machine Screw	S-08512-2	A-B-E	.05
Washer	W-08022-2	A-B-E	.01

F. AMPLIFIERS, SPEAKERS AND PARTS

Description	Part Number	Use	Price
Power amplifier	AO-2632-1		$ 55.00
Preamplifier	AO-15331-1	A-B-D	29.00
"	AO-15335-1	E	31.00
Speaker, 5 prong	AO-2353-1	A20,A&B40	18.00
" 6 "	AO-2353-2	A20,A&B40	18.00
" 5 "	AO-15888-3	C&DXR20	18.00
" 6 "	AO-15888-4	C&DXR20	18.00
Speaker head (cone & frame assembly)		All speakers	7.50
Power amplifier parts:			
(As used in A-20's below 999, A-40 & B-40 below 2300)			
Power transformer (old style)			9.35
30 mfd. 450 volt dry replacement filter condensers			2.85
Filter choke	AO-16356-0		3.75
Output transformer(tropic proofed)	AO-16364-1		5.25
Resistor & terminal strip assembly			3.30
(A-20's above 999, A-40 & B-40 above 2300 & all others)			
Power transformer (new style)	AO-16353-1		15.75
Oil filter block	AO-2813-0		11.75
10,000 ohm 10 watt resistor			.45
Filter choke	AO-16356-0		3.75
Output transformer (tropic proofed)	AO-16364-0		5.25
Resistor & terminal strip assembly			3.30
Preamplifier parts:			
Filament transformer	AO-17830-1	A-B	3.25
" "	AO-17831-1	E	3.30
Output transformer	AO-17826-0	A-B-E	2.50
Tone control potentiometer	AO-16532-0	A-B	.65
" " " , dual		E	1.25
8 mfd. filter condenser		A-B	1.25
25 " bypass "		A-B	.85
Oil filter block	AO-15096-0	B-E	4.50
1 mfd. condenser	AO-17566-0	B-E	1.45
Amplifier mounting parts:		(for 1 amp.)	
Mounting cup	PO-1962-4	4	.07
" spring	PO-2351-8	4	.06
" sleeve	PO-15462-0	2	.02
Spacer sleeve	PO-15461-4	2	.06
Guard angle	PO-2982-4	1	.21
Amplifier retainer	PO-15438-0	2	.02

F. AMPLIFIERS, SPEAKERS AND PARTS (CONT'D)

Amplifier mounting parts (cont'd): (for 1 amp.)

Description	Part Number	Use	Price
Tapped plates	PO-15437-0	4	$ .05
Wood Screw (amplifier retainers)	WS-12111-4	2	.01
" " (tapped plates)	WS-0611-5	8	.01
" " (guard angle)	WS-0511-1	4	.01
Machine screw (amplifier mounting)	S-14114-4	2	.01
Hexagonal nut (amplifier mounting)	N-1411-4	2	.01
Fiber washer (amplifier mounting)	W-4001-0	1	.01
" " " "	W-4002-0	2	.01
" " " "	PO-2981-0	4	.01
Lockwasher " "	LW-1411-5	2	.01
" (retainer)	LW-12111-5	2	.01
" (tapped plates)	LW-06112-5	8	.01
Amplifier mounting plate assembly	AO-2896-0	1	2.25

G. RHEOSTAT & TERMINAL BOX ASSEMBLIES AND PARTS

Description	Part Number	Use	Price
Rheostat & terminal box assembly	AO-1996-1	A	13.95
" " " " "	AO-2848-1	B-D	24.00
" " " " "	AO-15325-1	E	39.00

Parts:

Description	Part Number	Use	Price
Rheostat assembly	AO-2022-0	A-B-D-E	18.00
Cam for rheostat	PO-2013-0	A-B-D	.28
" " "	PO-15188-1	E	.38
Condenser .5 mfd. 200 V	AO-2381-0	A	.48
" .25 mfd. 200 V	AO-2124-0	A-B-D-E	.39

H. SWELL PEDAL ASSEMBLIES AND PARTS

Description	Part Number	Use	Price
Swell pedal assembly	AO-1990-1	A	9.00
" " "	AO-15790-1	B-D	14.60
" " "	AO-15330-0	E	49.00

Parts:

Description	Part Number	Use	Price
Hinge & bearing assembly	AO-16347-0	A-B-D	.37
Crankshaft & hinge assembly	AO-1961-0	A-B	4.25
Rubber mat	PO-1876-0	A-B-E	.34
Connecting rod assembly	AO-15277-0	E	1.65
Collar	AO-15286-1	E	1.05
Pedal stop	PO-2965-2	E	1.50
Pedal indicator wire - long	PO-15357-0	E	.05
" " " - short	PO-15358-0	E	.05

I. CABLES AND PLUGS

Description	Part Number	Use	Price
6 Conductor cable only	AO-2779-0		$ .16
30' 6 conductor extension cable	AO-2883-1		4.82
50' 6 " " "	AO-2883-2		11.50
Console cable (50' long, spade tips)	AO-2876-1		11.65
5 conductor cable only	AO-2780-0		.16*
30" 5 conductor jumper cable (for B-40)	AO-2882-2		1.02
64" 5 " " " (for C-40)	AO-2882-3		1.55
50' 5 conductor extension cable	AO-2882-4		7.82
Echo cable (50' long, spade tips)	AO-2931-1		10.50
3 conductor cable only	AO-2495-0		.07*
54" 3 conductor cable (for B-40)	AO-2490-0		.60
Plug for 2 conductor cord	AO-2165-0		.09
2 conductor power cord	AO-2781-0		.07*
Console power cord (A-B)	AO-2884-1		1.80
" " " (E)	AO-15301-1		1.73
Tone cabinet power cord (for B-40)	AO-2885-0		.95
6 pole male plug	AO-2846-0		.16
6 pole female receptacle	AO-2845-0		.16
5 pole male plug	AO-2860-0		.16
5 pole female receptacle	AO-2867-0		.16
Cord grip attachment	PO-15288-0		.22
4 pole female receptacle	AO-16329-0		.16
4 pole male plug	AO-16331-0		.16

(* Cable price, per foot)

J. FREQUENCY REGULATOR AND PARTS

Description	Part Number	Use	Price
Model G frequency regulator	AO-15040-1 *		99.00

(*Used to furnish closely regulated AC to synchronous run motors in console when instrument is operated from DC, unregulated AC, or isolated small power plant source.)

Parts:

Description	Part Number	Use	Price
60 Cycle Vibrator Assembly	AO-15039-1		13.50
50 Cycle " "	AO-15039-2		13.50
Coil & mounting assembly (vibrator)	AO-15202		3.25
Coils only (vibrator)	AO-15087-1,2,3,4		.43 ea.
Neon glow lamp	AO-2895-1		1.00
Plug Assembly	AO-15218-0		.95
Power transformer			24.00

K. ROTOR TREMULANT KIT

Description	Part Number	Use	Price
Rotor tremulant kit			$ 65.00
Motor & mounting assembly	A0-16014-1		11.08
Fabric belt	P0-15958-0		1.10
Motor pulley and fan	A0-16009-1		9.75
Motor brace assembly	A0-16016-0		.18
Fixed resistor - 3500 ohm	A0-16031-0		.31
2 pole female receptacle			.38
Tension springs	P0-16001-0		.03
Terminal strip	P0-16002-0		.17
Toggle switch	A0-15983-0		.54
Foot Switch Kit	A0-16010-19		10.00
Foot switch assembly	A0-15990-1		4.95
Foot switch mercury button	A0-16005-0		.95

L. ECHO SWITCH KIT

Description	Part Number	Use	Price
Echo switch kit	A0-2939-16		21.50
Echo switch blank cover	A0-15439-0		.12
Screws for " "	WS-0471-8		.01
Echo switch	A0-2622-1		5.50

M. REVERBERATION UNIT

Description	Part Number	Use	Price
Driver assembly - (plate #2)			11.60
Driver coil assembly	A0-16060-0		7.40
Crystal, mounting & cable assembly	A0-16150-1		11.50
Connector ribbon	P0-16231-0		.02
Connector cable (crystal unit)	A0-16120-0		1.00
Upper lever assembly	A0-16204-0		7.25
Lever & cage assembly	A0-16205-0		.81
Rubber grommet	A0-16076-0		.20
Reverberation oil (damping)	A0-16345-1		.55 Pt.
Reverberation preamplifier	A0-16160-1		54.00
Coupling cable	A0-16158-1		2.10
Filament transformer	A0-16133-1		1.75
Output "	A0-16134-0		4.10
Coupling "	A0-16135-0		.29

N. TUBES

Number	Price	Number	Price
56	$ .80	RK49	$2.25
57	.90	43	1.10
2A3	1.95	5U4G	1.00
5Z3	1.10	6F5G	1.00
48	2.85	2A5G	1.00
6J7G	1.10	6J5G	.90

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